THE

FRANKLIN JOURNAL,

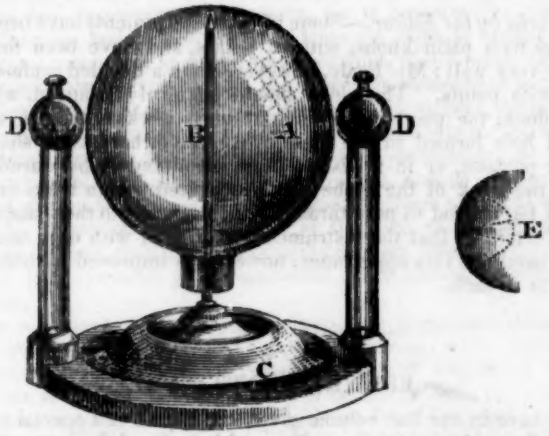
AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE USEFUL ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

JANUARY, 1827.

Description of an instrument by which electrical attraction and repulsion are illustrated in a new and striking manner. By the inventor, Mr. Franklin Peale.



To the Editor of the Franklin Journal.

Sir—Believing that every thing that can add to the attraction of science, or that can assist in the illustration of its principles, is more or less useful and acceptable to the public, I have taken the liberty

of sending you a humble offering, in aid of the cause in which you are so actively employed.

Several years since, in consequence of an examination of Rakestraw's electrical orrery, and the principles developed by its operation, I formed the instrument, a drawing of which accompanies this communication. I will briefly observe, that the charge of electricity being thrown upon the surface of the glass, the certain, immediate, and *rapid* revolution of the globe, is a simple, and yet effective illustration of the attractive and repulsive power of this agent. It is scarcely necessary to advert to the marked difference that exists between this instrument, and those in which *conductors* are made to revolve by the same agency.

Description.—The glass globe A is supported by the rod B, upon which it can freely revolve; the stand C supports also two pillars of glass, upon which are placed small conductors D D, within which are delicate points, placed as near as possible to the surface of the globe. E is an enlarged view of one of the small conductors, and the points within it.

One of the small conductors being connected with the electrical machine, and the other with the earth, the instrument is ready for operation.

Very respectfully, yours, &c.

FRANKLIN PEALE.

Philadelphia, 21st December, 1826.

Remarks by the Editor.—Some of these instruments have been constructed with plain knobs, without points, and have been found to answer very well; Mr. Peale, however, gives a decided preference to those with points. The globe should be nicely balanced, which is easily done; the point upon which it turns works either in a small conical hole formed in the glass by a piece of hard steel sharpened for the purpose, or in a disc of brass cemented on by warming the glass; the neck of the globe may be covered with a brass cap, perforated for the rod to pass through. It is obvious to those acquainted with electricity, that the instrument would act, with only one of the knobs insulated; its appearance, however, is improved by using glass supports to each.

FRANKLIN INSTITUTE.

We have in our last volume given the report of a special committee on the subject of Professor Renwick's inclined plane; another special committee was appointed to report upon two plans for Dry Docks, which, from the interest which the subject involves, and the high respectability of the projectors, and of the committee; will insure and reward an attentive perusal, by every one who is, or who wishes to become, conversant with the application of scientific skill to mechanical improvements.

Report of a select committee of the Franklin Institute, on a Dry Dock, projected by Commodore James Barron, and also, one by Captain Thomas Caldwell.

The Committee appointed by the Franklin Institute of the State of Pennsylvania, to examine the plan of a Dry Dock, submitted for examination by Commodore James Barron, of the United States Navy, and of another Dry Dock, submitted by Captain Thomas Caldwell,

Report, that the immense importance of dry docks, to the people of this great commercial nation, has induced the committee to delay the presentation of their report, in order that a thorough investigation of the merits, and defects, of the various plans now in operation, and of those now proposed to the Institute, might be effected.

The United States present the only instance existing, of a great commercial people, destitute of dry docks, for building, coppering, examining, cleaning, and repairing their national and commercial marine.

The large ships of war of the nation, are at present suffered to decay when serious repairs are requisite, which might easily be performed, if dry docks were in existence in the Union. The danger and expense from this neglect require immediate attention, and the national welfare demands the establishment of docks, without further delay. The system adopted by our merchants, in heaving down vessels of *large* dimensions, when repairs are required, is at once expensive, dangerous, and incomplete; expensive, for it requires the removal of their cargoes, and of many articles from the ships, to qualify them to withstand this severe and straining operation, whilst much time is lost, and much labour expended, in the processes subsequent to the heaving down, as well as in this preliminary operation; dangerous, as the violent, and unavoidable, straining of the timbers, bolts, copper, &c. must weaken and injure the vessels; incomplete, as thorough repairs cannot in many cases be performed, and as the injury done cannot always be completely ascertained, perhaps not until danger in a storm at sea reveals the extent of the evil, when discovery is almost unavailing, from the impossibility of then repairing the damage; for all these reasons your committee most strongly condemn this process.

Our merchants, aware of these facts, are sometimes compelled to send their vessels to the dry docks of Europe, when coppering, or serious repairs are requisite; the necessity of employing the shipbuilders of foreign, and sometimes of hostile nations, (with whom intercourse may be interrupted by national disputes;) and particularly our thus depriving of employment our own ingenious and skilful shipbuilders and mechanics, who are now frequently unemployed for a portion of every season, and whose labour is therefore lost to the nation, all dictate the necessity of a change; for it cannot be doubted, that, if dry docks existed in the ports of our country, all the operations of building and repairing vessels, could be performed *here* with *more*

economy, with *greater despatch*, with *equal excellence*, and with *far greater convenience*, than at present.

Many of these advantages will, in a comparative degree, be experienced by such ports, in our country, as may adopt docks, over such as are destitute of these highly important structures.

The committee consider it foreign to the object of their appointment to express any opinion in relation to the railway docks, which have been recently constructed in the United States.

Previously to commencing our examination of the comparative advantages of the plans now submitted to us, we will describe those which have been heretofore in use.

The dry docks employed in Europe resemble, in their structure, the larger class of locks which are used on canals; but they are, usually, far more expensive to construct, in proportion to their relative magnitude. Necessity frequently requires their location in a marshy or loose soil; the dock pit must be excavated to a great depth—frequently much below the surface of the adjoining harbour; much caution and labour are requisite to exclude, or remove, the water from the excavation. To prevent accidents from the adjacent earth slipping in, and thereby injuring, or retarding the works, it is frequently necessary to allow a considerable *slope* to the sides of the dock pits; consequently much labour is expended in the excavation. Many piles, driven to a considerable depth, are required—the masonry demands much labour to ensure durability, and hydraulic cement is indispensable. Stone dry docks are consequently very expensive structures; $75,000 or $80,000 being the least estimate which can be relied on for the cost of a dock,* (including the appurtenances,) calculated for vessels of 3 or 400 tons, and a larger sum for ships of greater magnitude.

A dock of this description could not be completed in less than one, and would, probably, require two years: the interest of the capital employed in constructing the work (which is unproductive during this period) will, of course, add to the above expense, and should no *delay* take place in *commencing* the docks, our shipping must inevitably suffer during the above period of time.

When stone docks are well constructed, few repairs are required; if, on the contrary, the plan, or the structure, be defective, much time, much delay, and great expenditure of money, may be required to maintain them in repair, or to remedy their defects.

When the height of the rise and fall of the tides is greater than the draft of the shipping for which the docks are constructed, steam, or other engines applicable to pumps, are not required to remove the water; but, with the exception of the extreme north-eastern coast of the United States, the maritime districts of our country will require docks in which pumps will be indispensable. The engine employed must be sufficiently powerful to perform this operation with expedition.

* The above estimate is calculated for the vicinity of Philadelphia; land, work-shops, sheds, and other buildings, are not included in it.

In the plan submitted to us by Capt. Thomas Caldwell, which is accompanied by a neatly constructed model, it is proposed to dispense with the use of pumps whenever a supply of water of sufficient elevation can be obtained. He proposes to construct a dock of about *twice* the usual length; to be divided into *two* compartments, by gates situated near the centre of the structure; an additional pair of gates are placed at the *extremity*, opening a communication with the harbour. The vessel enters this *first* compartment—the *external* gates are then closed, and the *internal* opened. The *bottom* of the *second* compartment is *above the level of the water in the first, or outer compartment*, and is consequently at this period *dry*. The water is now permitted to flow from the elevated reservoir, through a pipe, into the docks: when by this means the surface is sufficiently elevated, the vessel is hauled into the *second* compartment, which is constructed in all respects similar to a common dry dock; the central gates are then closed and secured, and the water is *discharged* into the adjacent harbour. This plan may be adopted in any situation, and is entirely independent of the tide, although this may occasionally be of some assistance.

All that is proposed in this plan is to save the *difference* in the expense of erecting steam engines, or other powers applicable to pumps, together with the cost of maintaining them in operation, compared with the cost of pipes, and of obtaining a supply of water. In the cost of these items some saving may perhaps be effected; but all plans of this description, however simple they may appear, must be *far more expensive* than any which are now in use. The money which would be required to construct the *external dock*, or rather lock, of which it is an exact resemblance, would be sufficient to construct one, and perhaps two, dry docks, on the common plan; whilst the interior dock will require the expenditure of the sum usually required, in addition to the former. Steam engines, or other power, could be maintained for a far less sum than the interest of the *extra* capital which we have mentioned above. The committee therefore cannot recommend this plan for adoption.

This method is by no means novel—it has been frequently described, but we believe never adopted.

In all docks, from which it is necessary to remove the water, either by means of pumps, or the action of the tide, some delay always occurs. It is sometimes important that ships should be enabled to proceed to sea with all possible expedition: this remark is applicable to our mercantile, but more especially to our national marine. The success of a naval expedition may depend on the *promptness* with which it can be equipt for sea. A single defective vessel may detain a whole squadron, until the defect can be remedied. The time lost in waiting for a single tide may be of consequence; hence docks, from which the water is removed by powerful engines, may, in some few cases, have advantages over those which depend on the tide for this purpose; the latter, however, are certainly more economical, both in their use and construction. The application of

these remarks will be considered, when we describe the plan of Commodore Barron.

The walls of dry docks necessarily exclude a considerable portion of the light, consequently the workmen are unable to perform their task early in the morning, or late in the evening; artificial illumination has sometimes been partially resorted to, for the purpose of lessening this inconvenience. From the cause above mentioned, some inconvenience is experienced from the want of ventilation; hence the vessels in the dock cannot, when requisite, be expeditiously dried, unless by the aid of fire, the employment of which, for this purpose, has been productive of numerous accidents. An additional evil, resulting from this dampness, and want of ventilation, may be observed in the diseases contracted by the workmen employed in such docks.

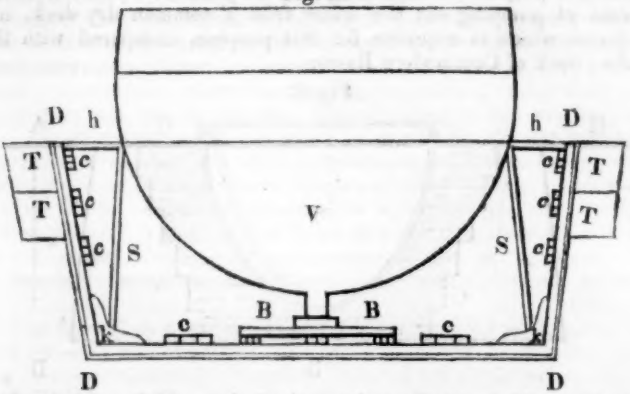
The hulks of old ships are sometimes employed in Europe as substitutes for stone dry docks: they are drawn ashore between high and low water mark, and carefully secured. The stern is cut off, and replaced by a pair of gates; the hold is partly filled with *ballast*, to reduce the buoyancy of the ship; the vessels enter at high tide, and are immediately secured by shores, &c. The water is permitted to escape during the subsiding of the tide; and afterwards kept excluded from the interior of the dock, during the time of repairing the vessel. This plan may be sometimes successfully resorted to for small vessels, in cases of *emergency;* but it is inapplicable to ships of great magnitude. In addition to this objection, an enormous quantity of ballast is required; and notwithstanding all the precautions which may be taken, accidents will sometimes occur from the employment of this insecure apparatus.

In the state of Maine, a plan similar to this has been attempted, but a vessel in the form of a camel, or rectangular trunk, has been substituted for the hulk previously mentioned. The least *inequality on the surface of the soil* on which it rests, will endanger its stability, by causing it to *warp*, and of course jeopardizing the safety of the vessel contained in it. In addition to this, it can only be employed where the tide rises and falls many feet, unless pumps be used.

We now proceed to describe the ingenious plan submitted to us by Commodore James Barron, of the U. S. Navy. It presents the appearance of a large scow, constructed in the strongest manner. The great simplicity of the features of this plan will render it perfectly intelligible by a mere inspection of the subjoined drawing, which represents a section of the dry dock.

D, D, D, D, the dock, k, k, knees at the angles bolted firmly to the horizontal and upright timbers D, D, D, D.—c, c, c, c, c, horizontal or inclined slips of ceiling running fore and aft, into which the timbers D, D, D, D, are inserted. The external planking of the dock is to be well caulked. T, T, T, T, are air tight trunks, to preserve the buoyancy of the dock when filled with water. V, the vessel in the dry dock. S, S, two of the wale shores supporting the ship h, h, horizontal shores. B, B, blocks under the keel.

Fig. 1.



Port holes, which may be rendered water tight, similar to those in ships of war, are placed at suitable intervals in the sides of the dock; these will permit the access of light and air, a great advantage which is not possessed by the *docks* now in use: these port holes also offer facilities for the introduction of timber, &c.

At the extremity of the dock, facing the harbour, the gate is placed—this may be of the usual form, or in detached parts, or the *floating gate* may be employed. The latter has been for a long time in successful operation in Europe.

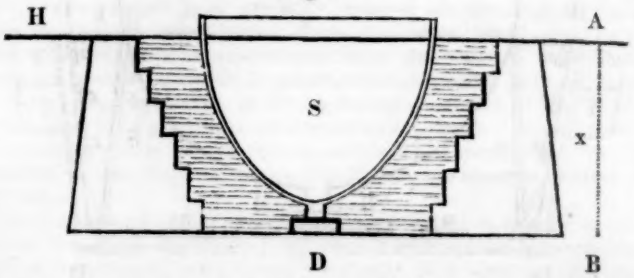
If this dock be employed in salt water, where the worms are destructive to timber, it will be necessary to protect it with copper, &c. This will be requisite only on the bottom and sides; the latter will require coppering only as high as the *floating line* of the dock containing the vessel, when the former contains *no water*. The same remark is applicable to the copper bolts. As the dock is exposed to little friction, the thinnest sheets of copper may be employed.*

We now proceed to describe the method of using this structure. When the gates are open the dock is full of water, and sinks to a depth sufficient to allow vessels to enter therein, and of course to displace their weight of water from the dock—when the gates are closed and secured. The vessel is then shored, &c. in the usual manner employed in dry docks. The water must be removed either by common pumps, by Archimedes' screws, or by a pump which forces out the water through an aperture in the bottom. This latter method is decidedly the best, for by means of it the water can be removed in one-fourth of the time which would be required by the first plan.

* If the experiments of Sir Humphrey Davy be conclusive, the copper may be perfectly protected from corrosion in salt water, by employing iron guards. The adhesion of barnacles, &c. which may be the result of preventing the oxidation of the copper, will be no impediment whatever to the operations of the floating dry dock.

For the purpose of explaining this subject, we will describe the process of pumping out the water from a common dry dock, and the power which is requisite for this purpose, compared with the floating dock of Commodore Barron.

Fig. 2.



In figure 2, D represents *a dry dock of the usual form*, S the ship, H, A the level of the water in the harbour and dock, the line A, B, the depth of the dock, for instance 20 feet.

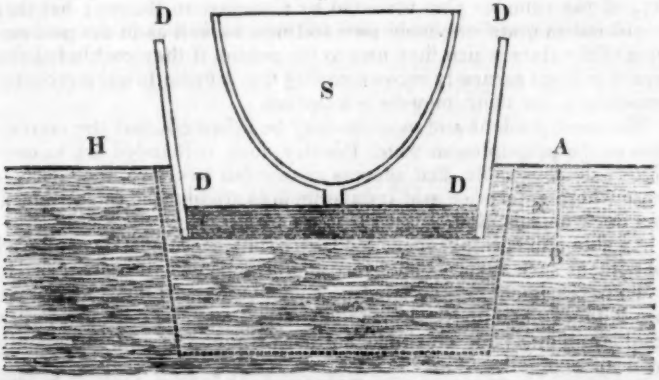
At the *commencement* of the operation of pumping, as the *level* of the water in the dock and harbour is the *same*, no power is requisite to remove the water from the dock, (if the friction of the pumps be not considered,) as the pumping proceeds, the *surface* of the water in the *dock* sinks *below the level*, H, A of the water in the harbour; of course, power is now required *to elevate* the water. The difference between the height of these two surfaces continually increases, until the last portion of water in the bottom of the dock is to be removed, when the elevation to which the water must be raised is the greatest, viz. from B to A, (20 feet) of course the greatest power is required at this period of the operation. Therefore if every foot in depth of the dry dock contain equal quantities of water,* the *average* power required during the *whole* of the operation must be sufficient to elevate a quantity of water equal to the cubic contents of the dry dock, to a height equal to *one-half* of the depth A, B of the dock, D. viz. to the half of 20 feet = 10 feet = x. A. This supposes that the level H. A. of the water in the harbour remains constant. In the floating dock of Commodore Barron, much less power is required to remove the water.

Let D, D, D, D, figure 3, represent the floating dock, containing the ship S. H, A, the surface of the water in the harbour, which would coincide with the surface in the dock, supposing it to be sunk to the dotted line, which is its situation when full of water: this depth we suppose to be 20 feet, or equal to A, B, figure 2. At the commencement of the operation of pumping the water from the floating dock, it resembles the common dock in not requiring any power to ex-

* In practice the *lower* portion of the dock will, from the form of the enclosed ship, contain more water than the upper portion, and of course require more power, and more pumping to remove it.

haust it; but as the pumping proceeds, the dock becomes lighter, and of course the bottom does not remain in the same relative position to the surface of the water in the harbour, but rises in proportion to its buoyancy.

Fig. 3.



The above figure (3) represents this dock as having risen in consequence of the removal of the water, H, A, being the surface of that in the harbour; it is now immersed to the depth of A B, only, which, in a dock of the magnitude hereafter to be mentioned, will be about 5 feet,* consequently, as the water is forced out through an aperture in the bottom, the *greatest* resistance to be overcome is equal only to the pressure of a column of water, equal in height to the line A, B, (5 feet) half of this, or A, x, = $2\frac{1}{2}$ feet, will be the *average* resistance during the whole operation. Therefore the power required to remove the water from the floating dock by a forcing pump, will be to the power required to remove the water from a common dry dock on the usual plan, as $2\frac{1}{2}$ is to 10, or as 1 to 4, viz. as A, x, figure 3, =to $2\frac{1}{2}$ feet, is to A, x, figure 2 = 10 feet. If, however, lifting or forcing pumps be employed to pump the water up, and discharge it *over the sides*, the *same* power would be required both for the fixed and for the floating dock: of course the forcing pump previously mentioned, will be adopted for the floating dock.

The dock of Commodore Barron is to be moored in a slip between two wharves or breakwaters, which will flank and protect it from injury; a raft, or floating breakwater, moored in the harbour in front of the dock gate, will preserve it from damage by storms, &c.

The repairs of this structure can be effected with despatch and economy—if the bottom requires inspection, the dock can be hauled up on a common building slip, and examined.

* As it will not be necessary to remove the water from the space occupied by the ballast, (represented by the shaded compartment in the lower part of the figure,) the additional depth to which the dock will sink, will not affect the result of the calculation we have given.

No danger can be apprehended from the bottom, or other parts of the dock warping, for this can be prevented by proper care in the construction.

Your committee have now fully, and decidedly, stated their opinion of the ingenuity, the economy, the safety, and the perfect practicability, of the valuable plan invented by Commodore Barron; but they would fail in gratifying their own feelings, as well as in the performance of the duty which they owe to the public, if they concluded this report without earnestly recommending this scheme to our mercantile community, for their immediate adoption.

The most prudent and cautious may be informed, that the correctness of the principles on which this dry dock is founded are so completely demonstrable, that success cannot fail to crown the efforts of those whose enterprise may induce them to attempt the establishment of a dock on this plan.

An able and faithful superintendant, or engineer, must be employed, as, without such supervision, every similar scheme will prove abortive.

The experiment may be tried, on a small scale, by those whose caution induces them to dread the failure which may, by some possibility, result from any plan which has not been frequently and successfully reduced to practice.

In the event of a trial, only $4,400 need be *expended* on a floating dry dock, calculated for the reception of vessels of 300 tons. Wharves and floating rafts, which will form a sufficient temporary protection, can be easily procured—common pumps, worked by men or horses, will be sufficient to remove the water.*

If the experiment be successful, the most ample remuneration must inevitably be the reward of the proprietors—if the plan proposed be unsuccessful, the materials of which the dock will be constructed can be sold for $1,400, and a loss of $3,000 only can possibly occur. The dock can be finished in the short space of two months.

If the experiment on this scale be successful, (and of this the committee do not entertain the smallest doubt,) the most timid will not hesitate to try the plan on a larger scale, and with the additions thereto which convenience may require. All which is respectfully submitted by

J. Humphreys, *U. S. N. Consr.* John Randel, jun. *Civil Eng.*
Chs. Stewart, *U. S. Navy.* Geo. W. Smith,
A. J. Dallas, *U. S. Navy.* †John Wilson, *Civil Eng. of S. Carolina.*
Hartman Bache, *Topog. Eng.*

* The total expense of these items for a permanent establishment will not exceed $6000; or the *total* expense for such an establishment will be only $10,400.

† It may be proper to state, that Mr. Wilson was present at the several meetings of the committee, and approved of the notes then taken by the Secretary. As these required some alteration in their arrangement to render them fit for publication, and as Mr. Wilson was compelled to leave Philadelphia in the interval, it was impossible for him to attach his signature in time; and it has therefore been done during his absence. This explanation is due to him and to the public.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. XII.

BY PETER A. BROWNE, ESQ.

On the law of Patents for new and useful Inventions.

Having, in the last essay, concluded our remarks on that rule which requires that the invention or discovery should be *new*, we come now to the next qualification of an invention, in order to give validity to the patent, which is that it shall be *useful*.

The proviso in the statute of James, is, "so as also they be not contrary to the law, nor mischievous to the state, by raising the price of commodities, nor generally inconvenient."

The 1st section of the act of congress says, "that when any person or persons, being a citizen, &c. shall allege, that he or they have invented any new and *useful* art, machine, &c. &c."

Lord Coke, 3 Institutes, 184, says: "Fourthly. The privilege must not be contrary to law. Fifthly. Not mischievous to the state, by raising the price of commodities at home. Sixthly. Not to the hurt of trade. This is very material and evident. Seventhly. Not generally inconvenient."

Most of the above qualifications enumerated in the proviso of the statute, and relied on by our annotator, are, it is believed, included in the comprehensive word, "*useful*," which is found in the act of congress. That which is illegal, mischievous, hurtful to trade, or generally inconvenient, cannot be USEFUL.

It is stated in Hawkins' Pleas of the Crown, B. 1. ch. 79. s. 24, that "it hath been holden, that a new invention to do as much work in a day by an engine, as formerly used to employ many hands, is not within the said exception, because it is *inconvenient* in turning so many labouring men to idleness."

For the authority of the rule, there are cited 3 Institutes, 184 and 10 Modern rep. 181. In the former we find the following. "There was a new invention found out heretofore, that bonnets and caps might be thickened in a fulling mill, by which means more might be thickened and fulled in one day, than by the labours of fourscore men who got their living by it. It was *ordained* that bonnets and caps should be thickened, and fulled, by the strength of men, and not in a fulling mill, for it was holden inconvenient to turn so many labouring men to idleness."

The word "*ordained*" is used by Lord Coke, which refers to a *statute*, and not to any principle of the common law, or adjudged case. And in truth his lordship refers in the margin, to several ancient (and it is believed obsolete) statutes, one of which made in the 22d year of the reign of Edward the 4th, (1483) ch. 5 enacts, that no person shall full, or thick, any hats, bonnets, or caps, at any fulling mills, or set to sale any so fulled, upon pain to forfeit 40*s*.

In the latter book, namely, 10th Modern rep. 181; there is no such decision as is quoted; nor is there in any English book of reports that

we have examined, a case, or dictum, to justify the general assertion made in Hawkins. We therefore feel ourselves warranted in saying, that it is not, nor ever was, the common law of England. Nor are they prohibited by the statute.

The case of the king v. Arkwright, 1785, referred to in Bul. N. P. 77, four issues were joined on the record of a scire facias, to repeal a patent: the first was, that the patent was *inconvenient* to his majesty's subjects, in general. Under this issue, it was most probably intended to overturn the patent, upon the ground that, being a labour-saving machine, it was not within the statute. It was a machine for preparing silk, cotton, flax, and wool, for spinning. But Buller J. held, that the first issue was merely a consequential one; it stated no fact which could be tried by a jury, or which the defendant could come to answer, and therefore he refused to hear any evidence but what applied to the other issues. In the famous cases of Boulton and Watt, v. Bull and Hornblower, (1795) and of Maberly v. Boulton and Watt, (1799) which, in their discussions, commanded the talents of the first characters of the British bar, this objection was not relied on by the counsel, nor directly mentioned by the court.

C. J. Eyre expresses himself thus: "In the list of patents with which I have been furnished, there are several for new methods of manufacturing articles in common use, where the sole merit, and the whole effect produced, are the *saving of time and expense*, and thereby lowering the price of the article, and introducing it into more general use." A sentiment utterly irreconcileable with the idea that patents taken for labour-saving machines, are invalid. I therefore feel myself warranted in asserting that labour-saving machines *are* within the proviso of the statute of James, and are proper subjects for a patent. In the United States, the propriety of their being secured by patent, has never been judicially called in question.

In an action brought for infringing a patent right, the plaintiff must prove that it is *useful*. This was decided by Sir Vicary Gibbs, in Bovill *v.* Moore, in 1816. "In point of law (says he) it is necessary that the plaintiff should prove that this is a new and useful invention, in order to entitle himself to the present action."

By the term "useful," mentioned in the statute, is meant not an invention in all cases superior to the modes now in use, for the same purpose, but *useful* in contradistinction to frivolous, and mischievous inventions.

In Lowell v. Lewis, 1 Mason's reports, 182, which was a contention respecting the patent of Jacob Perkins, for a useful invention in constructing pumps, one ground of defence was, that it was not useful. Judge Story charged the jury, that "the plaintiff must establish the invention to be useful; for the law will not allow the plaintiff to recover, if the invention be of a mischievous or injurious tendency. The defendant, however, has asserted a much more broad and sweeping doctrine; and one, which I feel myself called upon to negative in the most explicit manner. He contends, that it is necessary for the plaintiff to prove that his invention is of general utility; so that in fact, for the ordinary purposes of life, it must supersede the pumps in com-

mon use; in short, that it must be, for the public, a better pump than the common pump; and that unless the plaintiff can establish this position, the law will not give him the benefit of a patent, even though, in some peculiar cases, his invention might be applied with advantage. I do not so understand the law. The patent act uses the phrase '*useful invention*' merely incidentally; it occurs only in the first section, and there it seems merely descriptive of the subject matter of the application, or of the conviction of the applicant. The language is, 'when a person, or persons, shall allege, that he, or they, have invented any new and useful art, machine,' &c. he or they may, on pursuing the directions of the act, obtain a patent. Neither the oath required by the second section, nor the special matter of defence allowed to be given in evidence by the sixth section of the act, contains any such qualification, or reference to *general utility*, to establish the validity of the patent. Nor is it alluded to in the 10th section as a cause for which the patent may be vacated. To be sure, all the matters of defence, or of objection to the patent, are not enumerated in these sections; but if such a one as that now contended for, had been intended, it is scarcely possible to account for its omission. In my judgment the argument is utterly without foundation. All that the law requires, is, that the invention should not be frivolous, or injurious to the well being, good policy, or sound morals of society. The word '*useful*,' therefore, is incorporated into the act, in contradistinction to *mischievous* or *immoral*. For instance, a new invention to poison people, or to promote debauchery, or to facilitate private assassination, is not a patentable invention. But if the invention steers wide of these objections, whether it be *more or less useful*, is a circumstance very material to the interest of the patentee, but of no importance to the public. If it be not extensively useful, it will silently sink into contempt and disregard."

The next qualification of the invention is, that, in ENGLAND, it must be a *manufacture;* in the United States it must be an *art, machine, manufacture, or composition of matter.*

The prohibitory part of the statute of James, is much more extensive in its terms, than the proviso, as a comparison will show. The prohibitory part says, that all monopolies, &c. &c. for the sole buying, selling, making, working, or using, &c. The proviso includes only working and making; leaving out the buying, selling, and using.

Again. The enacting clause inhibits the sole buying, selling, making, working, or using *any thing;* the proviso saves *any manner of new manufactures.* The only thing then, which under this statute can be legally patented, is the *working*, or *making new manufactures.*

Here an important question arises; what is the meaning of the word "manufactures?"

Manufactures, in its ordinary sense, means "composition of things." But the sense in which it has been adjudged to have been used by parliament, is much more extensive.

Lord Kenyon in Hornblower v. Boulton, 8 Term rep. 99, (1799) defines *manufacture* to be "something made by the *hands* of man." This is giving it a very general signification; but I believe it will be

found to be still more extensive than this definition admits. Watt's patent was for a *method* of lessening "the consumption of steam, and fuel, in fire engines;" and on the most solemn argument it was held valid. There is an embarrassing obscurity in the reasoning of the judges in the above case, which arises from their employing the technical terms, "*principle*," "*method*," "*engine*," &c. &c. in different senses; but the gist of the decision is plainly this, that the *method*, or *means*, by which a new and useful thing can be effected, is patentable, provided the author describes particularly the process by which it can be practically accomplished. Now this method, or means, cannot be said to be the work of men's *hands*.

The decisions upon the statute of James, warrant me in saying, that the word "manufactures," includes two distinct things.

1. The *method* or *manner* of working or making a thing. 2. The *thing* worked or made.

1. The *method* or *manner* of working or making a thing. The first rule with respect to this is, that it must not be a *mere abstract or philosophical principle*.

This is admitted by Lord Kenyon in the case last quoted, page 98. He says, "the principal objection made to this patent is, that it is for a *philosophical principle* only, neither organized, or capable of being organized; and if the objection were well founded in fact, it would be decisive."

So Gross J, in page 101, says, "as to the first of these propositions, that under the statute of James there cannot be a patent for a *mere principle*, it is not necessary for me to form a decided opinion in that point." And afterwards, in the same page, he adds, "I am not prepared to say that a patent for a *mere principle*, was intended to be comprehended within these words." Lawrence, Justice, page 105, says, "if it were necessary to consider whether or not *mere* abstract principles are the subject of a patent, I should feel great difficulty in deciding that they are."

In Barrett v. Hull, 1 Mason's reports, 470. Judge Story says, "in the minds of some men, *a principle* means an elementary truth, or power; so that, in the view of such men, all machines, which perform their appropriate functions by motion, in whatever way produced, are alike in principle, since motion is the element employed. No one, however, in the least acquainted with law, would for a moment contend, that a *principle*, in this sense, is the subject of a patent."

But if the patentee describes the particular method, or manner, in which the principle can be applied, so as to produce a new, and useful effect, that is a "*manufacture*," and is patentable.

Watt's invention before noticed, is an instance. It is a practical application to all fire engines, of the philosophical principles, of the expansiveness, and condensibility of steam. So also Hartley's invention for securing buildings from fire, by the method of disposing of iron plates, as justly observed by C. P. J. Eyre in 2d H. Blackstone's rep. 493, was not a patent for the iron plates, but for a mere negative quality of absence of heat, *by means of the disposition of them*.

Lord Kenyon says, that no technical words are necessary to ex-

plain the subject of a patent. It seems from the list of patents produced in the case in 2 Hen. Blackstone's Reports, and from what is said by Rooke J. that the word in general use in England to express this kind of invention is "*method;*" but I cannot agree with Lawrence J. that *method* means "*engine.*"

Judge Story, in the case of Barrett v. Hull, 1 Mason's Reports, 470, to what was above quoted, adds, "The true legal meaning of the *principle* of a machine, with reference to the patent acts, is *the peculiar structure, or constituent parts of such machine.*"

The second acceptation of the word "manufacture," will be considered in the next essay.

ON ENGRAVING.

(From the Mechanics' Gallery. By C. F. Partington.)

(Continued from page 312, vol. 2.)

On Engraving upon wood, and on glass.

The history of *wood engraving*, to which we would now direct the reader's attention, is exceedingly interesting.

With regard to the origin of the art, Papillon tells us of eight engravings on wood, the account of which was given to him by a Swiss officer. These must have been considerably more ancient than any thing now known, and upon which a decided opinion may be given with respect to the date. The title, according to that author, ran thus: *Les Chevaleureux Faits en figures du grand & Magnanime Macedonian Roi, le preux & Vaillant Alexandre, dedie, &c.* "A representation of the Warlike Actions of the great and magnanimous Macedonian King, the bold and valiant Alexander, dedicated, presented, and humbly offered to the Most Holy Father, Pope Honorius IV. the glory and support of the church; and to our illustrious and generous Father and Mother; by us, Alexander-Alberic Cunio, Chevalier, and Isabella Cunio, twin brother and sister: first reduced, imagined, and attempted to be executed in relief, with a small knife, on blocks of wood, made even and polished by this learned and dear sister, continued and finished together at Ravenna, from eight pictures of our invention, painted six times larger than here represented; engraved, explained by verses, and marked upon the paper, to perpetuate the number, and to enable us to give them to our relations and friends, in remembrance of friendship and affection. These were completely finished by us both, at the age of sixteen only."

If this story be true, and such engravings with the foregoing title ever did exist, they must have been executed in the years 1284, or 1285; for Honorius IV. to whom the work is dedicated, sat only those two years in the Papal chair. But as Papillon gives this story upon the sole evidence of the Swiss officer, and had never seen any part of the engravings, the generality of authors have not been inclined to give much credit to the tale, which at best is exceedingly doubtful.

The most probable conjecture concerning the origin of this species of engraving is, that it was introduced into Germany by the **BRIEF-MALERS**, or painters of the playing-cards, who cut the outlines of figures on wood, and stamped them upon the paper, to save the trouble of making a separate drawing for every card; and afterwards coloured them by hand. Precisely in this manner were executed the blocks for the cuts in the edition of the Apocalypse, which is now preserved in the Bodleian library at Oxford.

Baron Heineken asserts, that cards for playing were invented in Germany, where they were in use as early as the year 1376, though the reason he gives is not by any means conclusive: *parcequ'on les connoissoit vers ce temps en France*, "because they were known about this time in France." Other authors, with Bullet at their head, as confidently assert, that they were invented in France. The disputes upon this subject serve only to prove the difficulty, if not the impossibility of ascertaining the era of the invention of cards, or the country in which they were first produced. This, however, is of no consequence to the present inquiry, unless it could also be proved that a part of them was printed on blocks of wood, at the time of their first invention. There seems to be very little doubt but that they were drawn, and painted, by hand.

The wood most proper for engraving upon, is box-wood, which should be cut to the height of printing types, by slices from the trunk of the tree, cut at right angles to the pith. This is done in order that the engraving may be executed on the end of the wood, as the graver will not, in all directions, make a smooth stroke upon any other side of the wood, nor would the work be so durable, if the fibres did not stand perpendicularly, while the block would be more liable to warp.

The piece of wood being planed very smooth, the design is drawn upon it with a black-lead pencil; then every black line which the engraving is to exhibit, is to be left untouched, but all the intermediate spaces are to be cut out, with the square or lozenge gravers, used on copper, or with tools of various sizes, with handles like gravers, and the same length, but shaped like chisels. In this process it is obvious that manual dexterity is the main requisite.

The art of *engraving upon glass* appears to have been suggested by the experiments of the French chemists towards the close of the last century. M. de Puymaurins, who is generally considered to be the first who treated upon this subject, thus describes his earliest experiments.

"Imitating the process of engravers upon copper with aqua fortis, I covered a piece of glass with a coat of wax, and, having drawn some figures upon it, I applied fluor-acid over the whole, and exposed it to the sun. I observed soon afterwards that the lines which I had drawn were covered with a white powder, arising from the dissolution of the glass. After four or five hours I took off the coat of wax, and cleaned the glass. I then found, with the greatest satisfaction, that my conjectures were true, and I was thereby assured that a skilful engraver might, by means of the fluor-acid, engrave upon the hardest glass, in the same manner as he can engrave upon copper with aqua fortis.

"But though the result of my first trial was such as to encourage me to proceed, I could not help remarking that the lines of the engraved figure were of unequal thickness, and full of irregularities. As I was ignorant even of the first principles of engraving, I could not hope to be able to bring this discovery to perfection; but I thought it right that I should endeavour to remove those causes to which the inferiority of my work was owing.

"The coat of wax had been laid on too thick, which had prevented me from giving to the outlines of my drawing, the delicacy they ought to have had; and the action of the fluor-acid had rendered them thicker in those parts where the coating was not evenly laid on.

"I soon found that it would be necessary to make use of a varnish, which should be sufficiently thin to admit of shading, and performing other delicate parts of engraving; and at the same time so strong, that, when applied evenly upon the glass, it should not be taken off, or destroyed, by the action of the acid."

The difficulty of applying a substance of that kind upon the surface of glass, makes this part of the operation very troublesome. The strong varnish used by engravers, was found to answer pretty well, but the smallest negligence in applying it, renders it apt to scale, and to be penetrated by the acid. The glass then becomes dull, the lines are rough, and consequently the engraving is imperfect. To bring engraving upon glass to its highest perfection, therefore, it will be necessary to discover a new kind of varnish, which shall have the properties requisite for the purpose. M. de P. tried, with tolerable success, the strong varnish of the engravers, described in the French *Encyclopédie*, and which is composed of equal quantities of drying oil and mastich. But it is very difficult to apply it evenly; and it is very long in drying, especially in winter, as it requires to be exposed to a pretty strong heat, in order to deprive it of its pitchy quality.

Before the varnish is applied, the glass must be thoroughly cleaned, and heated, until the hand can be hardly borne upon it. The varnish is then to be applied lightly over the glass, and laid smooth by dabbing it with small balls of silk stuffed with cotton. It is then to be exposed to the smoke of small wax-candles, as is done by the engravers with respect to copper-plates, when they make use of aqua fortis.

When the varnish is very dry, and the surface very even, the figure intended to be engraved, is to be traced in it. But the dark colour of the glass not showing the lines, as copper does, the engraver cannot see what he does, unless he holds the glass up to the light. As this situation would necessarily render his work difficult and troublesome, M. de P. contrived a table, the upper part of which might be raised in form of a desk, and consequently make the task of the engraver more easy. In the middle of this table, a pane of glass is fitted; upon it the engraver places the varnished glass on which the engraving is to be made. The glass having light thus thrown under it, the lines made by the engraver's tool become visible, and consequently, he can not only work with great ease, but can judge of the effects his work will produce.

Artists alone can give to this invention the extent and perfection

which it is capable of receiving. But it may not be amiss to inform them of the precautions which are necessary, to prevent their losing, in an instant, the fruits of a tedious and tiresome operation.

It is necessary, First, to be well acquainted with the quality of the glass made use of. Secondly, to ascertain the strength and purity of the fluor-acid. Thirdly, to attend to the temperature of the atmosphere.

Bohemian glass is not of an equal quality in all its parts; the substances of which it is composed have not undergone a sufficient fusion to be well mixed. The fluor-acid acts upon it unequally; the lines engraved upon it are rough, and have not a good appearance, except when viewed on that side of the glass which is opposite to the engraving. English glass, in the composition of which a great quantity of calx of lead enters, is easily acted upon by the acid, but the least defect in the varnish lets the acid penetrate; the calx of lead is first acted upon, and its solution gives a disagreeable tinge to the glass. Plate-glass is the substance which the acid acts best upon; the siliceous earth is there so prepared by the heat it has suffered, that the acid meets with it in the state most proper for its action.

That plate-glass which has a white reflection, not a green one, must be chosen. The glass used for small looking-glasses seems to merit the preference. The lines of the engravings made upon it, are equal in depth, and have no irregularities.

It is necessary to know the degree of purity of the acid employed. That which is distilled in a glass retort (being mixed with sulphuric acid, and saturated with the siliceous earth of the retort) is less strong, and less equal in its action.

In the summer season, when the weather is clear and serene, a piece of plate-glass, varnished, traced, and covered with the acid, is exposed to the sun, the engraving is completed in five or six hours; this is known by a white powder, which covers the lines drawn upon the glass. In winter, the glass is but slightly attacked in four days, and the operation would never be finished, if the action of the acid were not assisted by a moderate and regulated heat, such as that of an oven, or a stove. The glass must not be heated by applying heat under it, because the varnish thereby becomes soft, and scales off; the acid consequently penetrates to all parts, and the glass is made rough, without any regular figure being produced.

We may engrave on glass either in relief or otherwise. If it is proposed to engrave in relief, the varnish which covers the ground on which the figures are traced, must be taken off with a scraper; the fluor-acid must then be applied, and spread evenly with a small brush. If the action of the acid is assisted by the heat of the sun, the glass soon becomes covered with a white pellicle; which is to be taken off, and fresh acid applied, until the ground is thought to be so much deepened, that the figures have a sufficient relief. When it is proposed to take the polish from certain parts of glass, the same operation may be practised.

To engrave in the common way, the glass must have a border of

engraver's wax put round it, and, in all other respects, we must proceed as is usual in engraving with aqua fortis.

In order to judge of the state of the engraving, a corner of the glass must be exposed, and examined. If the operation appear to be finished, the acid is to be poured off, and the same acid may sometimes be employed more than once. The glass is to be drained, then washed two or three times with clean water to take away the superabundant acid, and afterwards dried. The varnish may be taken off with a coarse cloth, dipped in spirit of wine, and the glass may be cleaned with chalk finely powdered.

On Clock and Watch-making, and on purifying oil for pivots.

We have now lying before us a very excellent treatise on Watch and Clock making, by Mr. Thomas Reid, of Edinburgh.

This gentleman having retired from the active pursuit of his profession, to which his whole life has been devoted, has now, at the advanced age of fourscore, completed a work, which we have little hesitation in saying, is the best treatise on the subject, extant. In it, he has endeavoured to combine his own observations with those of the best practical writers, and to give to the operative watch and clock-maker, a condensed view of the art in Great Britain, and on the continent of Europe. The work consists of thirty-three chapters, with an appendix, and is embellished with twenty plates of engravings. On the subject of oil for watches and clocks he gives the following information.—*Ed. Lon. Mech. Mag.*

A receipt to deprive oil of its acid.

To four ounces of the best spermaceti oil, add four grains of *kali æratum* in five ounces of distilled water, shake them well for a day or two, then pour the whole into a tumbler, covered by another, and when exposed to the light for three or four weeks, the pure oil will float on the top, to be skimmed off by a tea-spoon. This oil, it is said, neither dries nor turns green.

Oil may be prepared in the following manner:

Put a quantity of the best olive oil in a phial, with two or three times as much water, so as the phial may be about half full. Shake the phial briskly for a little time, turn the cork downwards, and let most of the water flow out between the side of the cork and the neck of the phial. Thus the oil must be washed five or six times. After the last quantity of water has been drawn off, what remains is a mixture of water, oil, and mucilage. To separate these from each other, put the phial into hot water for three or four minutes, and most part of the water will fall to the bottom, which must be drawn off as before. The oil must then be poured into a smaller phial, which being nearly full, must be well corked, set in a cool place, and suffered to stand for three or four months, or until the water shall have subsided, with the mucilage above it, and the oil perfectly transparent, swim-

ming on the top of the mucilage. When time has thus completed the operation, the pure oil must be poured off into smaller phials, and kept in a cool place, well corked, to preserve it from the air. This, by Mr. E. Walker, of Lynn, dated 13th Nov. 1810. (See Nicholson's Philos. Journal.)

The fat or oil which is left in the pan after making calves-feet jelly, if taken and put into a jug or bowl, and allowed to remain for some months, what swims on the surface may be skimmed off, put into a small phial, and kept there for some time; this will be found to be a very fine kind of oil, at least it has the appearance of being so.

A French chemist, of the name of Jodin, prepares an oil, adapted for the use of watch-makers; it resists the cold to a considerable degree, but in time will become green at pivot holes, like most other oils. Olive oil freezes at 38° or 36° of Fahrenheit's thermometer; but if put into an open glass phial, and exposed to the sun-shine for a little while, it will not be apt to freeze till the thermometer is down to 21°.

As the amount of friction, even in the best clocks, in a great measure depends upon the oil, with which the various parts are lubricated, the following information may be considered of some importance. Colonel Beaufoy states, that olive oil may be freed from its mucilage, merely by exposure to the rays of the sun for one or two years.

Chevereul, an eminent French chemist, recommends another process for the same purpose. To effect this, he mixes seven parts of alcohol with one of oil, which must be heated in a flask almost to boiling; the lighter fluid is then decanted, and on being suffered to cool, a little portion of fatty matter separates, which is to be removed. The alcoholic solution must be evaporated to one-fifth of its bulk, and the fluid part of the oil will be deposited colourless, tasteless, and free from smell. This oil seems much like what was called Arabian oil, lately (April, 1825) exhibited in Edinburgh. The printed description given with it, gave neither name of an inventor nor any place of abode, a circumstance somewhat extraordinary, and unless a great quantity of it was to be taken, none could be purchased.

Of old, watch-makers were taught not to allow the small phial, which contained the olive oil, to stand even in the light, far less to be exposed to the rays of the sun, because this deprived it of its yellow colour, which was considered to be a quality of the goodness of the oil. And now, the moderns, by depriving it of that colour, say they improve it.

Oil extracted from poppy seeds, and properly prepared, will remain uncongealed at a very low temperature. Almond, walnut, and hazelnut oil, if freed from the mucilage with which these oils are frequently intermixed, may be tried for watches. It was formerly an object of inquiry, to know when a jar of Florence oil was in a frozen state, which sometimes took place in severe winters—a portion of it remaining unfrozen, was taken out for the use of watch-makers.

We are informed that M. Frederic Schmidt, of Stutgard, has discovered an oil for chronometers, &c. which will not freeze at minus 17 of Fahrenheit's thermometer; does not dry at × 212, and boils

at 512; it is not affected by cold at upwards of 50 degrees below the freezing point. M. S. is of opinion, in which he is confirmed by experiments, that this oil will not be affected under the poles.

The process of pouring the water off between the cork and the neck of the phial, was found to have something in it awkward and clumsy; we therefore got a large phial of about 17 or 18 inches deep, and two inches wide, made with a glass stopper at top, and another at the side and close on the bottom, to let the water out, which answered the purpose extremely well. Also, a few long sort of phials, with ground glass stoppers to each. The tall phial and its stop-cock was found very convenient in the process of washing with water, and letting the water out occasionally, to give room for more fresh and clean water. Oil thus prepared, and afterwards carefully managed, will perhaps be found to be as good as can in any other way be obtained; some of it we prepared in this way, and applied to the pivots and holes of the clock in the Royal Observatory, Edinburgh. This clock was taken down to be cleaned about the beginning of the year 1825, after having gone nearly twelve years; the pivot holes had a little greenish and thick oil in them, but in the reservoirs it was in some degree tolerably fresh and yellow. It is singular that the washing did not deprive it of its yellow colour.

How to preserve the oil, by making such reservoirs as to allow the greatest quantity to be put to the pivots and holes.

To have the pivot holes, so as to preserve the oil for the greatest length of time, with the greatest quantity possible, the following is what should be done, if a little more expense can be allowed:—For those holes, where the pivot ends do not go beyond the surface of the plates, fit into a drill stock, a drill made so as to form something like a drop of fat, when dropped on a table, or such like surface, making the diameter of the artificial drop, to be made by the drill near to four-tenths of an inch or so; in a thick piece of plate brass, make a round hole to receive the drill; the piece of brass must be fixed outside on the frame plates, so as the pivot hole shall be in the centre of the round hole, in order to guide the drill, which must be allowed to cut no further down in the plate, than barely to come to the surface, which should be left to remain, particularly at the pivot hole. A kind of collet might be put on the drill to prevent it from sinking too deep. The drill has the cutting part concave; the inside of the pivot holes may be chamfered a little way by a tool, whose point should be a little on the obtuse side; pieces of hard steel must be screwed on, outside of the plates, so as to cover fully the sinks made by the concave drill, and against the pieces of steel, the pivot ends should occasionally bear; the shoulders of the pivot should be turned nearly away, leaving a sort of cone in their place, and near to the shoulder, or top end of the cone, with the point of a very nice graver, make a slight notch.

The shape of a drop of fat (goutte de suix) at the top of a pivot hole, was a thought, or contrivance, of that celebrated artist, the late Julian Le Roy, and a most beautiful idea it was. (It is to be regret-

ted that it was not adopted in a clock, otherwise very nicely got up, and for public purposes.) Between the hard steel pieces and the top of the dome, formed by the concave drill, there should be a small degree of space; if they are too close, the oil will spread too much over them, and if at a proper distance, the oil will be attracted to a point connected with the pivot ends, gradually draining the reservoirs to supply the waste at the pivot holes.

FROM THE GLASGOW MECHANICS' MAGAZINE.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. II.—*Bleaching Apparatus.*

Sect. I.—As many of the most useful improvements in bleaching, consist in ingenious inventions of machinery and apparatus, by means of which the chemical agents employed are economised or rendered more efficacious, it would be unpardonable in an essay of this kind to omit their consideration. Such improvements also often depend on a minute acquaintance with the chemical composition of bodies; and inconveniences, which previously could not have been foreseen, may, by a skilful chemist, often be avoided, or at the very least explained; and nobody need be told, that when a difficulty is once understood, it is half overcome. A good instance, among others, of the use of chemistry, as it regards merely the apparatus for bleaching, may be seen at page 24 of the present number.

It is, however, no easy matter to obtain accounts of these, as the inventors commonly conceal their improvements in order to benefit by them; and it is usually a considerable time after an improvement of this kind has been made, that any account of it is given to the public. When patents, indeed, are taken out for such inventions, we can obtain descriptions of them from the specifications, but patents are not always sought, even for improvements of much importance, and in this case we must be contented to remain ignorant of their existence till they come into general use. I shall not take time to describe such machinery and apparatus as have now been disused, but shall confine myself to the consideration of what is at present employed by the most enlightened bleachers, so far as I can obtain the requisite information; and shall, for an estimate of the comparative advantages of the old and new apparatus, refer to Berthollet, Rupp, Des Charmes, Parkes, and the article Bleaching, in the Edinburgh Encyclopedia.

The apparatus differs according to the sort of goods, which are to be bleached; but I shall restrict myself here to an account of that used for linen, and heavy cotton goods; leaving such parts as are peculiar to the bleaching of wax, wool, silk, and paper, till I come to treat of the processes which are used for these substances.

As it is indispensable in good bleaching to have goods thoroughly washed at several stages of the process, and as to perform this manually would be both troublesome and expensive, particularly in works of great extent, several contrivances have been fallen upon for the ready performance of this operation on the large scale. The principal of which are the wash-stocks; and the dash-wheel and squeezers.

A machine, called the wash-stocks, is chiefly used in Scotland and Ireland. It is made on the same principle as the fulling mill, and differs from it but little. Two beams of wood are collaterally suspended by pivots upon a frame, so that they can move freely backwards and forwards. In the lower end of each beam, and almost at right angles with it, is mortised a piece of wood called the stock, which at one end is irregularly sloped. The cloth is put in a frame, or box, of wood, (elm is best,) into which runs a copious stream of water; and the stocks, with their sloped end inwards, play upon the cloth and gradually wash it. The cloth, during the process, is frequently turned, in consequence of being beat by the stocks against the end of the box containing it, which is of a round form. The stocks may be put in motion by a power from a steam-engine, or by a water-wheel, either with cranks or wipers, and ought to make from 20 to 30 strokes in a minute. (Ramsay.)

The dash wheel and squeezers are more recent contrivances for the same purpose, and are generally used in England and some parts of Scotland. The dash-wheel is a water-wheel, about six or seven feet in diameter. and two or three feet wide, which is closely boxed up all round. The inside is divided by wooden equi-distant partitions into four compartments, into each of which is a lateral opening, through the frame work for introducing the cloth. There are also small holes for the purpose of admitting and draining off the water used in cleansing, from the goods. For the purpose of introducing the water, there is sometimes an open circle made laterally near the circumference of the wheel, into which a water pipe is made constantly to play. This circle is crossed with numerous wires, (which should be made of brass,) to prevent the escape of the cloth during the process. While the wheel revolves, the cloth is raised up in one part of the revolution, and by its own gravity it falls down in another; and an agitating motion is thus produced, which proves very effectual for washing the cloth, while at the same time it does not weaken nor injure its fabric. The dash-wheel ought to go at a velocity of about twenty revolutions in the minute, which is by much too quick to serve at the same time the purposes of a water-wheel; a strong objection where it is necessary to economise the disposable water. In the neighbourhood of London they do not make their dash-wheels with close frames, but of sparred work, upon which the water plays freely from a pipe terminating near the upper circumference, whose mouth is flattened so as to make the aperture wide and narrow. (Ramsay.)

The squeezers, as they are called, form a necessary appendage to the dash-wheel. By these, the water is pressed out after the washing is completed. They are constructed with a pair of wooden rollers

super-imposed upon one another, between which the cloth is made to pass, and is by their pressure freed of its water. The lower roller receives its motion from a mill or steam-engine, and the upper is pressed down upon it by means of levers, in the construction of which the mill-wright will judiciously consult existing circumstances. The frame in which the rollers run, is neatest and most durable when made of cast iron. The rollers themselves should be made of elm, beech, or sycamore. (Ramsay.) A large press is sometimes used in place of squeezing rollers, and is a much more expeditious mode of management, but cannot act so equally as the rollers. (Parkes.)

The machine used for washing in France, and other parts of the continent, has more resemblance to the wash-stocks than to the dash-wheel. As in the former, a trough is constructed of elm for containing the goods, holes are made in it for the egress and regress of water, and rammers or pestles of beech, which pass through the upper part of the trough, are alternately raised and let down by tripping pieces fixed on a revolving shaft, and working in mortices made in the beams of the rammers. An ample description of this machine may be seen in Des Charmes.

For the steeping of goods after the first washing, a large circular vat is used, called a sieve; which may be made of almost any kind of wood; as, chestnut, oak, or fir. Oak has the advantage of not shrinking or contracting so soon as fir; but if fir be used on account of its cheapness, care must be taken to avoid using the white deal, which transmits water like a sponge, and to select the yellow in preference; as on account of the resin it contains, it undergoes less alteration in the fluid. If the use of white deal or other spongy wood cannot be avoided, it will be proper to paint the vessel within and without with several coatings of white lead. Melted pitch, tar, or a mixture of yellow wax and resin, may be also used with advantage for the purpose of coating. Care must be taken that the sieve have no cracks or splinters, which might endanger the tearing of goods in taking them out, because the fermentation causes them to expand and press against the sides of the vessels. Belonging to this are two pieces of wood made in the form of a cross, to lay over the goods while steeping. (Ramsay and Des Charmes.)

The goods are boiled in a common boiler, to which a stop-cock is fitted below, to run off the waste ley. Cast iron is what is generally used in the construction of these boilers; for which, the substitution of wrought iron, as in the case of the boilers of steam-engines, would not at all answer, because it is so liable to rust from its attraction for oxygen. The cast iron, on the other hand, always contains a portion of oxygen approaching to saturation, and consequently has its natural attraction for that substance greatly diminished. But it, even, requires particular management to fit the cast iron boilers for the purposes of boiling and bucking. For if *new* boilers are used, the action of the alkaline leys, by their attraction for the carbon of the cast iron, infallibly detaches a portion of the metal, effects a solution, and produces stains in the goods, extremely difficult of removal. To remedy this inconvenience, the manufacturers *season* their cast iron boilers

by boiling in them, for several days, a quantity of waste alkaline ley, by which process a thin crust is formed on the inside of the vessel, that, in future, prevents the immediate contact of the alkali with the carbonized iron. This crust or lamina is probably composed of a carbonate of the alkali which has been used, together with some of the impurities with which the ley may be charged. A similar process of seasoning cast iron vessels must be attended to, when they are used in cookery. The boilers used in bleaching, are made to contain from 300 to 600 gallons of water, according to the extent of business. In order that their capacity may be enlarged, they are formed so as to admit a crib of wood strongly hooped, or, what is preferable, of cast iron, to be fixed to the upper extremity. For the purpose of keeping the goods from the bottom of the boiler, where the heat acts most forcibly, a strong iron ring covered with netting, made of stout rope, is allowed to rest six or eight inches above the bottom of the boiler. Four double ropes are attached to this ring for withdrawing the goods when sufficiently boiled, each of which has an eye for admitting hooks from the running tackle of a crane. Where more boilers than one are employed, the crane is so placed, that, in the range of its sweep, it may withdraw the goods from any of them. For this purpose, the crane turns on spindles at top and bottom; and the goods are raised or lowered at pleasure, by double pulleys and shelves, by means of a cylinder moved by cast iron wheels. The boiler should be fitted with a cover, well fitted, both to economise heat, and to prevent the admission of soot or other impurities, which may produce stains difficult of removal. (Parkes. Ramsay. Des Charmes.)

The bucking apparatus is of considerable importance, and we have already mentioned the improvements of it which have lately been made; as their adoption, however, is not general, it may be necessary first to describe that commonly used. A wooden sieve is made, similar to that used for steeping, and fitted with a false bottom of wooden grate work, a few inches from the true bottom, to keep the goods from coming in contact with the cover of the boiler. Through this cover is a valve to regulate the transmission of the waste ley. There proceeds from the boiler a short pipe slightly bent and placed in a horizontal direction, from the extremity of which arises a vertical pump, for the purpose of drawing the ley out of the boiler and pouring it on the goods. To effect this, a pipe similar to the one just described, runs horizontally from the pump to the sieve, where it throws the ley upon a cone of metal, which is supported by a bar of wood over the middle of the sieve, in order to diffuse the ley equally over the goods. The pump with its two pipes is not unlike the letter E, without its middle horizontal line; the sieve and boiler may be conceived to be placed in its bosom. This apparatus, which is the invention of Mr. John Lawrie of Glasgow, is certainly much more ingenious and convenient than that formerly used for this purpose; but it is greatly inferior in simplicity to that which I shall now describe.

I have not learned who invented the whale boiler, but it is an invention of great utility, and the principle upon which it is constructed is extremely simple and obvious. It consists, like that last mentioned,

in a common cast iron boiler and a wooden sieve, for containing the goods, but wants the pump, to work which, when the former is used, renders the process both tedious, laborious, and expensive. Within the sieve is fixed a false bottom perforated with holes, or made of spar work, for the ready transmission of the leys. From the middle of this bottom arises a pipe or flue, extending to the very top of the sieve, and in which, of course, the cold ley stands at the same level as in the boiler; but when it begins to boil, it immediately ascends through the flue with such force as even to rise above the brim of the sieve. Here it is stopped by a concave plate of sheet iron resembling an umbrella, which is suspended over the flue, and striking against this, by the impulse of the ebullition, it is equally distributed over the surface of the goods at the top of the sieve. Aided by the temperature to which it has thus been brought, the ley gradually permeates the whole of the goods in the sieve, and, reaching the perforated bottom, repasses into the boiler, whence it is again thrown up into the flue, and follows the same routine as before. This process is continued till the goods are judged to be sufficiently bucked. The importance of this ingenious contrivance requires no comment from me; it is likely, I think, in a short time entirely to supersede the other. Des Charmes seems to have been very near the discovery of this contrivance; for, in describing his clumsy boiling apparatus, he says, (page 312,) that the boiler must be fitted with a cover held down by cramps to prevent its being raised by the force of the steam caused by the ebullition, which stream of hot ley is "by these means *compelled to re-act* on the goods in the boiler." (Parkes.)

ENGLISH PATENTS.

To David Gordon and William Bowser, Iron-manufacturers, both of London, for coating iron with copper, or with alloys, of which copper is the principal ingredient, dated Feb. 26th, 1825.

The specification of the above patent, as published in the *Repertory*, is too prolix for our purpose, and the notice of it in the *London Journal of Arts and Sciences* does not satisfy us; we shall therefore make an abstract, and such remarks as may appear to us pertinent. The patentees state, that their "invention consists in the discovery made by them, that a clean surface of iron, brought to a white, or welding heat, or near thereto, is disposed chemically to unite with, and firmly to coat or plate itself with melted copper, into which such iron may be plunged, or on having melted copper poured upon, or over such surface of heated iron." "And in the further discovery made by them, that the union and adhesion of copper and iron occasioned in the manner aforesaid is so perfect, that plates of their patent coppered iron, when malleable iron is used, may be rolled out to a considerable degree of thinness, and may, by hammering or other means, be manufactured either in a cold or a hot state, into a vast variety of useful

articles, either completely, or partially covered with copper." The method which they recommend for heating the iron, and for melting the copper, is to construct two reverberatory furnaces, such as are in use in iron and copper works, so close to each other, that their ends shall be in contact; these furnaces are to be furnished with close fitting doors, and with dampers in the flues, made with great accuracy, so that the admission, and exit of atmospheric air, may be under the most perfect command; and that the air which has been deprived of its oxigen, by supporting the combustion, may, when required, be detained within the furnace. This is to prevent the oxidation (*rusting* or *scaling*) of the plates of heated iron. Great care is also to be taken that all the air admitted shall pass through a bed of ignited fuel, that it may be deprived of its power to oxidize (rust) the metal.

Between the two furnaces, there is to be constructed a sliding door, sufficiently large to admit of the heated iron being passed through, into the furnace containing the melted copper, into which they are to be plunged, and held down from one to fifteen minutes, according to the nature of the article, and the thickness of coating required. The iron is sometimes to be coated by pouring the copper upon its surface by means of ladles. For coating sheet iron on one side they propose to weld the edges of two plates together, then to treat them as single plates, and afterwards to clip off the welded edges. Another method proposed, is to bend up the edges of the plate, so as to form a tray, which may then be placed upon the melted copper, when the under side only, will be plated; otherwise they put into the tray thus formed, the quantity of copper which is allowed for the coating, in which situation it is to be fused, and made to adhere to the plate. Cast, as well as malleable iron, is to be coated by this process; and to prevent the oxidation, they sometimes dip the iron into rosin, or some similar material, which, they state, will be wholly evaporated before the iron acquires the requisite high temperature.

Charging holes are to be made in the furnaces, which holes are to have close fitting doors, lined with fire brick; through them the clean iron to be coated, or the copper to be melted, may be passed, when they are to be closed perfectly. Furnaces of other constructions, it is stated, may be used, as the form or nature of these, make no part of the patent; this consisting not in the apparatus employed, but in the end attained, namely, the complete coating of the iron with copper.

Appended to the specification in the Repertory are the following

OBSERVATIONS BY THE PATENTEE.

From the observation which Mr. Bowser and myself had made upon the very difficult operation of brazing my portable gas lamp-reservoirs, we were led to believe that iron might be coated with copper, and, having erected a very small furnace, we completely succeeded in coating small sheets and bolts in a sufficiently perfect manner. But as we have neither the opportunity of erecting sufficiently large furnaces, nor the command of large rolling mills, both of which would be requisite to turn the invention to much practical use, we have determined,

instead of ourselves forming an establishment for the manufacture of the articles, to grant licenses for the use of the invention upon the payment of a very small sum for the patent right; and in this way, we hope it may become extensively useful, and a national benefit.

We believe the invention suitable for steam, and other boilers, covering houses, making of coal scuttles, for the sheathing of ships, and almost every article where plate iron is used. For ships' bolts we consider it peculiarly adapted, as thereby may be obtained the tenacity of iron, with the durability of copper. A great variety of other purposes might be detailed, to which the invention is applicable, so soon as the manufacture of the article shall have been taken up on a large scale, because the coppered iron may be beat out, and bent, with as much facility, as copper plated with silver.

Since writing the above, my attention has been called by a friend, to an account given of the patent, in a contemporary publication of last month, the editor of which, has thought fit to put in italics the words "has a great disposition to unite chemically with melted copper," which is an incorrect quotation, and to criticise the expression, but in a manner which proves that he does not know the real meaning of the word "chemically."

With regard to the paragraph at the end, wherein the editor states that he has no hesitation in calling the two patents of Mr. John Pool, in the year 1816 and 1822 "*the same*" as the above recited one, I have only to request *any one capable of judging*, to read the three specifications, when I am sure *he* will find them *totally different*.

DAVID GORDON.

33, Cornhill, London.

Observations by the Editor.—We have but little interest in discussing the correctness of the opinions of Editors or of Patentees, on the other side of the Atlantic; but it becomes a duty so to do whenever our observations may prevent their erroneous conclusions from producing error in opinion, or in practice, among ourselves. That the patentees may have coated iron with copper, and have applied the iron so coated to various useful purposes, we have no doubt; but that they made the discovery, "that a clean surface of iron, brought to a white, or welding heat, or near thereto, is disposed chemically to unite with, and firmly to coat or plate itself with melted copper," we certainly do not believe. The fact that there is an affinity between iron and copper, is known to every one who has any claim to the name of chemist; there are but few treatises on chemistry in which the alloy of copper and iron is not mentioned; bells formed of this alloy have been cast in great numbers in the city of New York, and probably elsewhere; and long before the time of the editors, or of the patentees of the present day, the common blacksmith brazed (soldered) pieces of iron together, by means of copper, when something more tough than brass has been thought necessary; and although the smith was no chemist, he was, in this case, performing a chemical operation.

Mr. Gordon has, we think, made a fair *hit* at the editor of the *London Journal of Arts*, who denies that the union of the two metals is a

chemical union, and presumes that the patentees "have found out, that when iron and copper are heated to certain temperatures, and brought into close contact, the particles of the two metals are more susceptible of being mutually affected by the abstraction of cohesion, than under any other circumstances; and taking advantage of this knowledge, propose, under those very circumstances, to perform the plating process."

We confess that we do not know any thing either of mechanical or of chemical philosophy, which will enable us to understand the above illustration; but we write for practical men, and cannot afford room to discuss this point, as it would not interest them; and for our scientific readers it is unnecessary. To the former however we will say a few words upon the difference between those effects which are chemical, and those which are mechanical; but these shall be reserved for another page, and we will place our observations under the head of "The Artisan."

Gordon and Bowser believe their invention suitable "for the sheathing of ships;" for ship's bolts, they "consider it peculiarly adapted." These gentlemen appear not to know, or not to have considered, the galvanic action which would result from this combination of copper and iron, and which would inevitably, and in a short time, destroy the sheathing, and the bolts so used, in consequence of the rapid oxidation of the iron. The incompatibility of copper sheathing and iron bolts had been observed long before the discovery of galvanism; the action of this power will not be, in the slightest degree, prevented, by the close contact produced in the operation of coating.

We have examined the patents of Mr. John Pond, and confess that we think, with the editor of the Journal of Arts, that they are very similar to that of Gordon and Bowser. The manipulations are in some respects different, but the end is in general the same. Pond covers an ingot of iron, &c. with copper or brass on one or both sides, and rolls the ingot afterwards into sheets; whilst Gordon and Bowser propose, generally, to plate the iron after it is rolled; still the iron is covered with a coat of copper or of brass, and that, in consequence of the *chemical* union of the metals. Pond mentions the coating of ornaments made of iron, by dipping them into fused brass or copper, and striking them with a hammer, on taking them from the melting pot, to remove the superfluous metal. The iron is first to have its surface cleaned, and then covered with sal ammoniac and borax. It appears to us that this process might be advantageously followed in many cases, but particularly on ornaments of cast iron.

Specification of the Patent granted to WILLIAM DAVIDSON, *of Gallowgate, in the city of Glasgow, Surgeon and Druggist, for a process or processes for bleaching or whitening bees-wax, myrtle-wax, and animal tallow.* Dated August 1, 1826.

To all whom these presents shall come, &c. *Now know ye*, that in compliance with the said proviso, I, the said William Davidson, do hereby declare, the nature of my said invention, and the manner in

which the same is to be performed, are particularly described and ascertained in the following description thereof, (that is to say:)—I combine liquefied bees-wax, myrtle-wax, or animal tallow, with oxymuriate of lime, oxymuriate of magnesia, or an aqueous solution of either of them, by stirring the same with a wooden or other spatula, or otherwise in any suitable vessel, and I decompose these salts by some acid, which has a greater affinity for the lime, or magnesia than the oxymuriatic acid; such, for instance, as sulphuric acid. For melting the wax or tallow I use an iron vessel, lined internally with lead, or any other suitable vessel, and heat it by means of a common furnace, or by steam, applied in any way that may be considered most advantageous. I then combine in this leaden or other suitable vessel, about one hundred and twelve pounds weight of liquefied bees-wax or myrtle-wax, with about an equal weight of a solution of oxymuriate of lime, heated to about the temperature of boiling water and having allowed the mixture to become a little consolidated, I add to it from fifty, to one hundred ounces of sulphuric acid (of the usual mercantile strength, say of specific gravity 1·8485) previously diluted with about twenty or thirty times its weight of water, and boil them, whilst agitation with a spatula or otherwise is employed, until the lime is completely separated from the oxymuriatic acid. The solution of oxymuriate of lime which I employ for bleaching bees-wax, and myrtle-wax, is made by dissolving from about fourteen to twenty-eight pounds weight of the salt in about one hundred and twelve pounds weight of water.

For bleaching animal tallow, I generally use from two to five pounds weight of the oxymuriate of lime to one hundred and twelve pounds weight of tallow, with a proportionate quantity of water to dissolve the salt, dilute the acid, or supply the loss by the subsequent boiling. However, these proportions of oxymuriate of lime and sulphuric acid for bleaching bees-wax, myrtle-wax, and animal tallow, are not absolute, but a greater or less quantity of the oxymuriate of lime and sulphuric acid is necessary in proportion to the greater or less quantity of colouring matter in the wax or tallow. In those cases where the wax or tallow is not sufficiently bleached by the process, I repeat it.—*Repertory of Pat. Inven.*

Specification of the Patent granted to Abraham Henry Chambers, *Esq. of Bond-street, in the County of Middlesex, for an improvement in the manufacture of a building cement, composition, stucco, or plaster, by means of the application and combination of certain known materials hitherto unused (save for experiment) for that purpose.* Dated January 15, 1821.

To all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I the said Abraham Henry Chambers, do hereby declare that the nature of my said invention,

and the manner in which the same is to be performed, are particularly described and ascertained in the following description thereof: (that is to say) I do hereby declare that my aforesaid improvement consists in the use and employment of certain burnt or vitrified earths, or earthy substances, and of certain metallic and other substances, which I cause to be ground, or otherwise reduced to powder, and then to be mixed and incorporated with the lime, for the purpose of producing mortar, plaster, stucco, or building cement, by whatsoever name it may be called or distinguished, thus producing a most perfect and efficient cement from artificial pozzalana. The earthy substances which I prefer for this purpose are all those kinds of clay or loam that are capable of becoming vitrified and intensely hard by exposure to a strong fire; consequently chalk and all the various lime stones and other earths, which become soft, friable, and capable of slacking or falling to pieces when exposed to heat, are unfit for the purpose aforesaid, but flint, or flint stones, or pebbles, may be used with advantage, notwithstanding they do break and fly into pieces when heated. A trial on a small scale will, however, convince any one whether any particular earth, or earthy, or stony matter is proper, to be used, which will be ascertained by exposing it to a very strong heat, when if it runs into a slag, or vitrifies, or becomes excessively hard, it may be used, but if otherwise, it must be discarded as unfit for the purpose. The proper kind of earth being thus selected, it must be heated either in the interior of a brick or other kiln, or in a kiln or furnace, formed for the express purpose, and which may be built either of bricks, or formed of earth, with proper vent-holes or flues, until it becomes completely vitrified, or reduced to a state of hard. black, or glassy slag, which in many cases will be found sufficiently hard to strike fire with steel. The harder and more vitrified the materials become, the better they will answer for my aforesaid improvement. The vitrification of some kinds of earth will likewise be occasionally assisted and improved by mixing refuse or broken glass, or even sand and wood ashes, before it is exposed to the action of the fire. I claim likewise the exclusive privilege of appropriating other slags, or vitrified materials which are not produced for the express purpose, to my aforesaid improvement, such as those which come from the furnaces of smelting-houses, glass-houses, foundries, steam-engines, or other boilers, and all materials reduced to a state of vitrification by intense heat. The whole of the aforesaid materials, whether produced for the particular purpose, or obtained from any of the before-mentioned sources, and whether consisting of vitrified earth, metallic, or other vitrified slag from furnaces, or burnt flint, or flint-stones, must be bruised, pounded, or ground by any of the usual, accustomed, and well-known methods, until it is reduced to such a grit as will be convenient and necessary for the formation of the particular sort of mortar, stucco, plaster or cement, which may be required for this purpose; it must be passed through such wire-screens, or sieves, as will produce the necessary fineness or quality, and being so separated into different qualities, it may be put up into casks, or otherwise preserved for use, and is a most perfect artificial pozzalana.

The manner of using the above material or materials is to mix it with well-burnt lime, instead of the sand usually employed for the formation of mortar, stucco, plaster or cement, water being added as usual, until it is of the proper consistence to be used; or the artificial pozzalana, or above materials may be mixed with quick lime completely pulverized and sent in casks or other packages ready to be used with the addition of water only. In this latter case, it will be necessary to keep it from moisture or exposure to the open air until the time of using it. The proportion of quick lime that must be added to the above materials will depend entirely upon the goodness or strength of the lime that is used. In general, one measure of good lime will be sufficient for, from three to five measures of the aforesaid materials, but this must be regulated by the work for which it is intended, and will be readily ascertained by a little experience. I hereby further declare, that another part of my said invention and improvement consists in the use and appropriation of marble of various colours, and of various coloured bricks, when highly burnt or vitrified, and reduced to fine powder for the purpose of producing all the variety of colours and shades required to imitate stone, and highly polished wood and marble. And lastly, I claim the exclusive right and privilege of using vitrified earth, and the aforesaid other materials for the purpose of mixing with lime, or plaster-of-paris, to cast figures, ornaments, and mouldings of every description.

In witness, &c. [*ib.*

Patent granted to James Ashwell Tabor, *Gent. of Jewin-street, Cripplegate, London, for means of indicating the depth of water in ships and vessels.* Dated Dec. 14, 1825.

Mr. Tabor's method of indicating the depth of water in ships, is by floats, which rise or fall in copper cases, placed close to the kelson, and which, by wires and small chains, turn the hands or indexes of a dial on the upper deck, according as the water in the hold is higher or lower.

As the ship will incline by rolling sometimes to one side and sometimes to the other, Mr. Tabor uses two copper cases, and two hands to his dial, each of which hands moves unconnected with the other, and one of which indicates the depth of the water at the larboard or left side of the ship, and the other that at the starboard side. The copper vessels, in which the floats are placed, are fixed one at each side of the kelson, and pass down close to the timbers through the limber boards, and are represented in the drawing of the specification as rising a small space above the kelson; at the top of each of these vessels a pair of rollers are fixed close to each other, between which a small chain passes, that connects the float which lies in that vessel with a wire, which ascends through all the decks to another small chain, that passes round a pulley on the part of the axis of the index, which is appropriated to that side of the ship. Each float has thus

separate vessels, wires, chains, and indexes; but, in order to combine the two indexes in one dial, the axis of one of them is hollow, and that of the other passes through it, each axis having its own index and pulleys, and moving independently of the other; as the chains and wires of the floats require to be counterbalanced, each axis has a second pulley on it, smaller than the first above-mentioned, round each of which a small chain passes, that descends, on the side opposite to that where the wires are placed; to this is attached a weight sufficient to balance the wires and the other chains; this ascends and descends in a vessel placed to receive it below the upper deck; the small chain being guided to it by a pair of rollers, placed above the vessel, between which it passes, in the same manner as the float chains pass between their rollers above the lower vessels, as before described.

The pulleys connected with the chains of the balancing weights are made smaller than the other pulleys, to cause the weight to require a less space for ascending and descending. The figures on the dial, will, by this arrangement, show the height of the water in the lower vessels belonging to the floats, according as the indexes connected with these floats are moved round, and point to them. Lastly, it is stated by the patentee, that springs might be used to counterbalance the wires, &c. of the floats, in place of the weights; but they are objected to, on account of their being liable to rust. [*ib.*

"UPWARD FORCES OF FLUIDS."

Remarks on Mr. Genet's "Memorial, on the upward forces of fluids," and also upon Dr. F. Pascalis's communication on the above subject, published in Silliman's Journal. By the EDITOR.

We, some months since, copied from the "Boston Journal of Philosophy," a notice of a publication by E. C. Genet, entitled a "Memorial on the upward forces of fluids;" to this notice we appended a few remarks, but did not intend ever again to bring Mr. Genet's reveries into public notice, because we viewed them as *harmless*, from their not containing any thing which could mislead an individual acquainted with the first principles of mechanical philosophy; and certainly we had not the wish, had we possessed the power, to prevent the admiration of the ignorant, at the stupendous effects to be produced by these newly discovered mechanical powers, the "upward forces of fluids." What a man publishes to the world, is a fair subject for criticism, unless it be too feeble, or too ridiculous to call forth serious investigation. Need we cite examples, to show that men, in many respects intelligent, have propounded the most absurd doctrines, and supported the most ridiculous projects, particularly upon the subject of mechanics? such instances are too numerous, and too well known, to require exemplification. From our intended silence, as regarded any further notice of the work of Mr. Genet, we have been diverted by an article published in Silliman's Journal for October last, written "by FELIX PASCALIS, M. D. President of the American Branch of the

Linnæan Society of Paris, &c. &c." When Richard Brothers prophesied, Nathaniel Brassy Halhed, M. P. testified to the inspiration of the fanatic; now, although we do not mean to say that Mr. G. is *as* crazy as Mr. Brothers, or that the Dr. is *as* learned as Mr. Halhed, we yet think that there is a degree of appositeness in the two cases, which must strike, on the instant. The Dr. thus commences:—

"It is often the case, in this age of much writing and printing, that Reviewers, or Editors of Journals, have the exclusive power to establish the reputation of an author, if they choose, or to deliver over his book to neglect and contempt. They may also raise a work much above its true merit and value. From this result there is not much harm, because public opinion must finally decide and award justice to the author. There is still a degree of retardation to the progress of science, of taste, or of other desirable improvements; but what is worse, is the fallen fortune of a book in the market. When it has once been lowered in the hands of wholesale or retailing venders, it never can be well restored; and what should command the sober and cautious attention of the readers, is, that they are themselves *duped*, in as much as not being aware of the comparative merits of the author and his reviewer, they take it for granted, that it is the duty of the latter to be impartial, while he is not even qualified to bestow either praise or censure.

"To these observations I was led, by reading, lately, much incorrect criticism, and many unfounded remarks, against Mr. E. C. Genet's Memoir on the upward forces of Fluids, on which I wrote something in the preceding number of this Journal. I hesitate, however, to be myself his encomiast, but I would rather be condemned to study again my experimental and mechanical philosophy, than to condemn any portion of it, much less his departure in part from the Newtonian philosophy. Have we not proofs enough in nature, that if there are many of its elements under centrifugal agency, there are others under a centripetal force?" * * * * * * *

The Dr. concludes with the following observations.

"Thus far we have succinctly described the æronaut of Mr. Genet, offering at the same time a view of all his plates. We are satisfied of the novelty and ingenuity he has displayed in each of his experiments and applications, but this remark is particularly applicable to the part upon which it may be said, that the whole labour of theorists and machinists has been during nearly 60 years concentrated, to find out the means of directing and regulating the course of a balloon after it is launched in the atmosphere.* We have abstained from the privilege of reviewers, who might have caught some cause of censure and criticism, although we are aware of a few inaccuracies, and of some material objections that might be offered against the theories of the author, as well as with respect to his mechanical applications. We think it better and more honourable to keep these under consideration, until he can avail himself of a farther revisal, and until the public opinion may have had a proper chance to be formed. There is no doubt but a sufficient number of qualified *judges* and experimen-

* Were attempts made to direct balloons nearly 20 years before they were invented?

ters may be found in this country, where mechanical pursuits and ingenuity are so often successfully applied to public improvements. A different course would appear to us exceptionable, inasmuch as Mr. Genet is not a philosopher of common stamp; nor has he departed from any principle in hydrostatics or in dynamics, that could not be supported, even, with some exception, to the Newtonian law of gravitation. The right of a patent which Mr. Genet has affixed to his discovery, will sufficiently protect him against any improper invasion, as well as the public mind against any dangerous error or application that could be apprehended from his speculations, and we should add, against unqualified witticism pointing at ridicule, or condemning his memorial to be dead stock in the booksellers' shops. 'Quæque ipse miserrima vidi.'"

Between these quotations, there are about eight pages of letter press, and four copper plates; the letter press is an abstract of Mr. Genet's book, intended to illustrate the contrivances, represented on the plates. We regret that we have not one of the latter, to manifest the truth of the Doctor's observation, that "Mr. Genet is not a philosopher of common stamp," and also that "*qui dit docteur, ne dit pas toujours un homme docté, mais un homme qui devroit être docté.*" Either of the plates would answer our purpose, although we should certainly prefer the third or fourth, as they appear to rise, by a regular climax, into the upper regions of absurdity. We should not be anxious, had we the power, to *condemn* the Doctor, "to study again his experimental and mechanical philosophy;" a shorter, and perhaps a more certain way to render himself one of the "qualified *judges*," would be to become an "experimenter", and to construct an *hydronaut*, or an *aeronaut*, upon the principles contained in the 'memorial' of his friend Genet; he will then be perfectly able, in this one case at least, to determine the question, "who's the *dupe?*"

Perhaps some of our readers may be provoked to release a copy of the memorial from its state of condemnation in the hands of the booksellers; for the satisfaction of such, we should not think any thing else necessary, than the possession of the work: but to those who may not pursue this course, we advise a reperusal of the remarks from the Boston Journal, p 41, of our last volume, to which we now add some further account of the hydrostatic ship, or boat, which Mr. Genet denominates an HYDRONAUT, (memorial p. 62) the machinery of which is to work "with a velocity of action, and uniformity of movement, superior to the best and most powerful steam boat engine." Before describing his newly contrived propelling machinery, Mr. G. gives some information relative to the steam engine, for the purpose of running a parallel between it, and his own newly discovered power. In doing this, he furnishes intelligence respecting the derivation of force in the steam engine, which is new to us, although we have constructed, and used this instrument, as well as studied, and explained its operation. We are told by him, that Mr. Watt has availed himself of the downward force of the piston, and weight of the steam engine, and that the force is created by the falling of the weight and piston, into a partial and momentary vacuum, and that its power is determined by the incumbent weight, and by the atmospheric

pressure. Our own conclusions upon the subject, were so unlike those of the "philosopher of no common stamp," that we had believed, and even publicly taught, that the weight of the piston, and of the other moving parts of the engine, served only to abstract from its power, and that provided they had the necessary degree of stability, the lighter they could be made, the better they would answer in practice. Instead of supposing that the pressure of the atmosphere, was necessary to the action of Mr. Watt's engine, we had taught that its structure might be simplified, and that its action would be more powerful, could it be worked in vacuo. Here is a great discrepancy; either we, or this uncommon philosopher, together with his encomiast, must be in the wrong, and need, in sober truth, to study again our experimental and mechanical philosophy. We are giving a fair, candid, and ungarbled statement of the doctrines taught by Mr. G. and let "qualified *judges*" decide between us.

The following question, with its answer, are from p. 61 of the memorial. "How does the engine perform that operation—how does it create that *vis motrix*, that moving force, which is the mechanical life of the machine? By the alternate increase and decrease of temperature, which produces in the cylinder two kinds of fluids, the one *gaseous*, the other *atmospheric*, by the means of which the piston raises and falls." We had fancied, that the *vis motrix* was caused by a vacuum on one side of the piston, and an elastic, but condensible vapour, on the other, and that the exclusion of *gaseous* and *atmospheric* fluids was of essential importance to its action; but we really do not understand the nomenclature here used by Mr. G. and of course, are not, in this case, qualified judges; we never learned that a vacuum was a gas, or that the vapour of water, was atmospheric.

But to the *hydronaut*. Mr. Genet may either not understand, or may have committed some mistakes in his explanation of the steam engine; he may have watched its *motions*, without having become familiar with its *disposition*, yet in his own child we might expect to find him perfectly familiar with both; we however, are a little inclined to suspect, that in this latter case, he knows more of the *disposition*, than of the *motion*.

The *proposed* moving power of the hydronaut, consists of two hollow copper vessels, called *hydrostats;* they are to be cylindrical, with conical ends, perfectly closed; these are to be suspended upon a beam, 24 feet long, resembling that of a steam engine, and are to hang below it, similar to a pair of scales upon their beam. These hydrostats are to be contained within two cylinders which stand under the beam, and in which they may freely rise and fall, when the beam vibrates. These cylinders are to be open at top, and to have a valve in the bottom of them, to open a communication with the water in the river; by some means, (what means we cannot discover,) water is to be made to flow alternately in, and out of these cylinders; that which contains water, will have the *hydrostat* immersed within it, forced up by its buoyancy, that at the opposite end being allowed to descend, in consequence of the removal of the water; and so on, *ad infinitum*. The machinery by which it is intended to remove the water, is to be worked by the same beam. This machinery consists, principally, of two pumps, oddly

enough, called *air* pumps; their piston rods are attached to the beam, they being placed within the main cylinders; to the beam is also appended the apparatus for opening and shutting the valves; a piece 14 feet in height, ascends from its centre, and from the end of this, a rod passes which is to act upon a crank, and give motion to the paddle wheels, whilst by the intervention of a *large wheel turning a pinion*, the velocity is to be increased. Should any one wish for a model of this machine, he may make it, by suspending an egg shell upon each end of a small scale beam, these will be his *hydrostats;* then by taking two glasses of water, and passing them alternately upwards, against the shells, he will cause the beam to vibrate; and if he can then only contrive to attach to the beam, something which will relieve his hands from the task of moving the glasses, he will have constructed a perpetual motion, exactly upon the principle of that of Mr. Genet. Should he be at a loss to see how this is to be done, we must refer him to the inventor, as we cannot direct him, even with the aid of the engraving, and of the book. "So the *hydronaut* will navigate, until it is stopped"—say the gentlemen concerned; we, however, feel inclined to transpose the sentence, and to say, "so the hydronaut will stop, until it is navigated."

We have extended these remarks to a greater length than we had designed, or than the intrinsic merits of the subject would justify; but when gentlemen who are members of learned societies, and who are confessedly very clever in particular departments of science, bring the influence of their names, and their talents, to the support of notions the most crude, and which manifest a palpable deficiency of knowledge, in the first principles of the particular branch of science, to which the examination belongs, it would be a culpable neglect of duty in the sentinels of science, to permit them to pass, unhailed. To talk about condemning a man because he has ventured to depart from the Newtonian philosophy, is to talk very feebly; whilst universal homage is paid to the genius of Newton, we know of no one who would pretend to establish a law, upon the opinions of that philosopher. The theories of Newton are as freely discussed in the scientific world, as the theories of any other man. What we understand by a departure from the Newtonian philosophy, is, not a departure from the deductions of that philosopher, but from the mode of philosophizing, by which these deductions were formed; and in this point of view, the case in hand, is a most fearful departure.

Information on the progress made in the various attempts to obtain a spontaneous flow of water, by boring the earth to a considerable depth. Extracted from "An Essay on the art of boring the earth," &c. &c. recently published, and for sale by Messrs. CAREY & LEA.

In page 34, of our second volume, we published some account of the operations of Mr. DISBROW, in boring for water in New Jersey. The essay above named is the production of the intelligent corres-

pondent who furnished that account. One principal object of the essay is "to prove that water can be procured by means of the art of boring, in any spot that the borer chooses, and that water may rise above the surface, independently of gravitating pressure." A considerable number of facts are brought forward in support of these opinions, which, if they do not prove the correctness of the theory assumed, serve at least to manifest, that the subject is worthy of more careful investigation than it appears to have received. The reasoning of the author is, we think, too hypothetical, but we should be careful not to permit this opinion to invalidate the facts upon which the reasoning is founded.

The essay contains a notice of twenty-four experiments, made by Mr. Disbrow; for the particulars of No. 1. we refer to the before named communication.

"*No.* 2. Commenced August 7th, 1824, about one mile from well No. 1, 47 feet above the level of the Raritan. Went through 60 feet of soft red shell, and struck the first vein of water—three feet of granite—blue shell—blue rock—at 110 feet came to a rock harder than granite: this rock was about four feet thick; in the centre of which, encountered loadstone; the poles of the borer were so strongly magnetized that a heavy jack-knife could be suspended from them. This stratum of loadstone seemed about 4 inches thick; came to water after passing the adamantine rock, through which the borer could only penetrate from two to six inches a day; went through various kinds of rock, some calcareous and others silicious. The red shell was always found at intervals; and water was almost always obtained either in the stratum, before encountering red shell, or else immediately after it. The strata of clay were never of any thickness, until towards the lowest part of the bore, when, after going through four or five feet of blue clay, at the depth of 394 feet, struck a vein of water, which immediately overflowed at the top, and is now, Nov. 14th, (1826,) discharging two gallons a minute, at the height of 2 feet 8 inches from the ground. This well is tubed to the depth of 194 feet, with a copper tube of one and a half inches diameter. It is regretted that no particular note was taken of the thickness of each stratum of rock as it occurred in this well, as there seemed to be a greater variety in this spring than in any of the others. It was thought to be finished in the winter of 1824, as the water ran above the surface; but it was found necessary to bore deeper. There was an ebb and flow in this well until it was bored deeper. The present tube must have shut out the particular vein that caused the ebb and flow as it is no longer apparent. The temperature of this spring, at the depth of 250 feet, was 52° Fahrenheit; now, at 294, it is 54°; thus adding another proof of the correctness of the opinion that the temperature increases as we get more into the interior of the earth.

"*No.* 3. Mr. Simpson's distillery, New-Brunswick. Began in Nov. 1824, and finished in Feb. 1825. Went through 7 feet of clay, and then 60 feet of red shell, when the first stream of water was struck. At the depth of 140 feet, a thin stratum of loadstone was encountered; the poles were strongly magnetized, but not equal to

that of well No. 2. The rock succeeding the loadstone, was gray granite, for a foot or two, when the red shell re-appeared. At 150 feet, there were indications of copper. This well is 176 feet deep, and cost 440 dollars; is tubed only 18 feet, and discharges two gallons a minute: 52° Fahrenheit.

"*No.* 4. In Dunham's Alley, in New-Brunswick, ten feet above the level of the Raritan. Began it in Feb. 1825. Bored through made ground for 12 feet, and then met with continued strata of red shell to the depth of 208 feet. Water now rises above the surface; but the boring has been discontinued for the present, as *Mr. Disbrow*, to whom this well principally belongs, is too much engaged to finish it. The water is above the surface, but the stream is trifling.

"*No.* 5. Jersey City. April, 1825. Level, 25 or 30 feet. Began to bore in a well 24 feet deep; water in it very brackish. Jersey City surrounded by salt water. Granite from the commencement to the present depth, which is 208 feet. Struck several veins of water after going 146 feet. By inserting a small pump, three gallons a minute can be raised. The water runs over the tube 21 inches, unaided by machinery. They are still boring. Water excellent.

"*No.* 6. Alexandria. Thirty-five feet above the level. Bored 23 feet in common soil, a stratum of iron ore, of about a foot thickness, 11 feet of quicksand and water, 11 feet of sand, 10 feet of coarse gravel, 90 feet of black alluvial, intermixed with wood and fibrous particles, &c.; two feet of gray stone, 96 feet of blue, yellow and gray clay. After getting through this clay, struck a vein of water, which arose to within 36 feet of the top. Bored to the depth of 450 feet, through different coloured clay, with now and then a stratum of coarse sand. Quitted in May, with the intention of resuming it again.

"*No.* 7. Hudson, New-York. Seventy feet above the level of the Hudson. Began in May, 1825; 40 feet clay, 30 of brown sand, 4 hard-pan clay and gravel. Struck a vein of water, which arose 17 feet; 70 feet of black slate rock, mixed with limestone. Still boring.

"*No.* 8. North side of the Raritan, half a mile from New-Brunswick; 80 feet above the level of the Raritan. Began in 1825, in the bottom of a well that was 48 feet deep, and quite dry; 60 feet of red shell; struck a vein of water which gave eight feet water to the well; indications of coal; red shell, and now and then thin strata of gray wacke, to the depth of 250 feet, when water came above the surface, discharging one and a half gallons at the height of seven feet. Cost about 400 dollars, and is tubed 100 feet, with one and a half inch copper tube, connected at intervals of twelve feet, with brass screw joints. These copper tubes cost 50 cents a pound; and the screws are 75 cents a piece.

"*No.* 9. Albany. Began May, 1825. Boyd & M'Culloch, Brewers. Level 20 feet above the Hudson. Began in a 30 feet wall; 11 feet of coarse gravel and hard-pan; 41 feet black slate rock; very little water until after passing a depth of 200 feet of same rock; struck several small veins. At 250 feet encountered inflammable gas. Now 280 feet deep, and water within four feet of the surface.

"*No.* 10. Albany. Waterworks Company. Began in August, 1825. Twenty feet of clay, sand, and gravel; 17 feet hard-pan; struck a vein of water which instantly overflowed at the surface, at the rate of five gallons a minute. The diameter of the bored hole of this spring was eight inches, whereas all the previous ones were from two and a half to two and three-quarter inches in diameter.

"*No.* 11. The same company are now boring back of the Capitol, in Albany, on very high ground, and are now, at the depth of 120 feet, in hard-pan.

"*No.* 12. New York. Manhattan Company. Began Sept. 1825. Level 40 feet above the Hudson. Bored 40 feet in sand and gravel; 60 feet in hard granite; from that depth to 240 feet, occasional veins of water; increasing in quantity as the depth increases; water, when a tube is introduced, now within 30 feet of the surface; discharges 12 gallons a minute, by means of a pump. When down to the depth of 260 feet, the chisel passed a vacuum of an inch; the water immediately sunk one foot; but in the course of a few hours, when the cavity was filled, the water again rose. This has been the case in several wells; boring still continuing.

"*No.* 13. Harper's Ferry. Began June, 1825. Level 12 feet. Very high mountains in the rear. Fifty feet of soft gray slate; 50 feet of granite, but not very hard; occasionally quartz and granite. At 110 feet, touched a fine vein of water: some quartz and granite at the depth of 264 feet. Discontinued for the present, but is to be resumed.

"*No.* 14. Baltimore. Mr. Bosley, two miles west of the city. Seven feet common soil: 33 feet rotten gray rock; 140 feet of the same rock, only harder; struck a vein of water, which arose to within 22 feet of the surface. Some mischievous person having at this time thrown in a piece of steel, it cost a great deal of time, labour, and money to cut it up, it being of 30 inches in length. The boring is going on, and much praise is due to Mr. Bosley for the liberal spirit he has shown in the prosecution of this work under so many discouragements.

"*No.* 15. Horsimus. Eighty feet above the level of the Hudson. Mr. Haight's Carpet Manufactory. Began June, 1825, in a well 30 feet deep, which did not give a sufficient quantity of water, as the machinery was idle one day in six. Bored 30 feet in sand, gravel, and hard-pan. Got plenty of water.

"*No.* 16. New-Hope. June, 1825. Sixty feet level. Eighty feet red shell, 110 limestone. Still going deeper.

"*No.* 17. Philadelphia. Mathew Carey, Esq. Began in a well 48 feet deep, quite dry. Thirty-eight feet of hard granite, and brought 4 feet of water in the well. Object obtained. Granite, therefore, in this case, as well as in the spring No. 5, in Jersey City, is intersected by veins of water.

"*No.* 18. Northern Liberties, Philadelphia. Level 40 feet. Forty-five feet sand and gravel; 145 feet gray granite rock, only varying from soft to hard. Struck several veins of water in this granite. Water at present within 25 feet of the surface.

"*No.* 19. New-York. Corner of Rivington and Columbia streets. Commenced Aug. 1825. By degrees sunk a cast-iron tube, and began in a well 20 feet deep. Ten feet quicksand; 20 feet marsh mud, and clay; ten feet gray clay; stopped at granite. All the upper brackish water is excluded by the tube, and there is a fine flow of water from the junction of clay and granite. This water is excellent, and is pumped up by a small pump.

"*No.* 20. New-York. Broad-street. Mr. Tunis Quick. Four feet common made ground, or street filling, of the consistence of mud; 6 feet of yellow clay; 19 feet gravel and quicksand; 10 feet of gray clay. Came to granite, fastened the cast-iron tube, and water arose to within 7 feet of the surface. Put in a pump; object obtained.

"*No.* 21. New-York, corner of Avenue D, and Fifth-street. Bored through 6 feet of common street filling; 10 feet marsh mud; 65 feet of quicksand and gravel; 15 feet of gray clay. Came to granite, and obtained fine water. Tubed 96 feet. Bore 8 inches diameter. Water within 4 feet of the top.

"*No.* 22. Dry Dock Company, corner of Avenue D, and Tenth-street. Six feet common filling; 10 feet marsh mud; 12 feet quicksand; 53 feet of common shore sand and gravel; 6 feet of hard-pan; 3 feet of coarse gravel. Stopped at the granite, and got plenty of water within 4 feet of the surface.

"*No.* 23. Newark Meadows, Grazing Company. At the junction of Belleville and Newark Turnpike, on the *salt marsh*. Ten feet of marsh mud, and roots; 12 feet of fine quicksand; 36 feet bluish gray clay; 6 feet sand; 20 feet of ash coloured clay. Met with water: bored 20 feet farther in very stiff variegated clay, on the reddish cast. Touched the red free stone, and stopped. Water excellent and soft, and within three feet of the surface. The reclaiming of salt meadows has been a great object obtained. The reclaiming of the fresh water springs is of still higher importance.

"*No.* 24. Allen-street, near Hester-street, New-York. Began in a well 40 feet deep, that had about two feet of brackish water in it. Commenced in quicksand: bored 20 feet: now and then a stratum of gravel: 2 feet clay, 5 feet of coarse gravel and sand. Obtained water, as is always the case, before coming to the solid rock. All the waters of these last mentioned wells are like the water of the old *Tea Water Pump*."

THE ARTISAN.—NO. 2.

Observations on Specific Gravity. By the EDITOR.

Practical men are daily becoming more sensible of the value of scientific information, in enabling them to pursue their respective arts to the greatest advantage; but appalled at the array of terms which they encounter on the very entrance on the paths of knowledge, and with which they are are not familiar, they retreat in dismay, consider-

ing the effort to advance, as altogether hopeless. To pretend that artisans will, or can, become men of general science, would be ridiculous; but there are particular branches of knowledge, which may be considered as isolated in a degree sufficient to make them attainable, without the necessity of passing through a regular routine of study, whilst by their natural connection with other branches, they will enlarge the mental vision of those who possess them, as assuredly as the ascending an eminence will extend the field of view, to the observing traveller. While attempting to explain these isolated branches of science, it is important to render their utility obvious, by showing their profitable application to the purposes of business. It was under these impressions that specific gravity was selected as a subject for the first number of "The Artisan," a subject which, in accordance with our promise, we now resume. The terms *heavy*, and *light*, are relative; thus, oak is heavy, compared with cork, and light, compared with the metals. In estimating the specific gravities of bodies in general, we have already stated that water is the article with which all others are compared; we may therefore, when treating upon this subject, consider water as the dividing line, and call those bodies heavy, which sink, and those light, which float on that fluid. Bodies sink, when they are heavier than a portion of water, equal to themselves in bulk; and float, when they weigh less than an equal volume of the fluid. Upon the same principles, we may consider ether as a light, and sulphuric acid, (*oil of vitriol*) as a heavy liquid; the former being only about three-fourths, while the latter is nearly twice the weight, of equal bulks of water.

For the methods generally pursued in ascertaining the specific gravity of solids, or of fluids, we must refer to what we have already published upon this subject. We are aware, however, that artisans will not, in general, procure hydrometers, to enable them to ascertain the strength of the spirits, the acids, and the other fluids which they employ in their respective pursuits, and that it is difficult, in most situations, to obtain such as are suitable; but a substitute for them, which will be sufficiently accurate for all practical purposes, may be procured every where. In one of our numbers on japanning and varnishing, (vol. 2, p. 102) we have mentioned such a substitute, but it may be well, on the present occasion, to be a little more particular on this point. A phial with a small neck, such as a cologne water bottle, and a pair of scales with small weights, include all the necessary apparatus. A weight should be prepared, which shall be an exact counterpoise for the bottle, and when placed in the opposite scale, will render the weight of the latter, of no importance in the calculations to be made. The bottle should have a mark made on it with a file, upon the narrowest part of the neck. Pure water should then be poured into it, until it just reaches the mark, when the bottle must be placed in one scale, its counterpoise in the other, and the exact weight of the water ascertained; which should be noted down, as this operation need be performed but once. When the specific gravity of any other liquid is required, the bottle, which must first be made clean and dry, is to be filled with it, exactly to the mark, and weighed; when, by having ascertained the weights of equal bulks of water, and of

the liquid in question, we are enabled, readily, to find its specific gravity, by the rule of three; the weight of water, being, in all cases, the first term, 1.000, the second, and the weight of the fluid under trial, the last. Thus, suppose we are essaying *sulphuric acid;* the water we will suppose to have weighed 1920 grains, and the acid to weigh 3456 grains; we then say, as 1920 is to 1000, so is 3456, to the specific gravity of the acid, which will be 1.80, or 1 and $\frac{8}{10}$ the weight of water, which is weaker than it ought to be; an acid of much less specific gravity than 1.85, not being accounted good. Extensive tables of specific gravities, both of solids and of fluids, may be found in most of the works on chemistry, or natural philosophy; we subjoin a few of each, by way of example, selecting those articles most commonly used.

LIQUIDS.		SOLIDS.	
Distilled, or rain water, -	1.000	Platinum -	20.980
Sea water, - - -	1.026	Gold, - -	19.257
Milk, - - - -	1.032	Lead, - -	11.352
Sulphuric acid, - -	1.850	Silver, - -	10.478
Nitric acid, - - -	1.580	Copper, -	8.895
Muriatic acid, - -	1.194	Iron, - -	7.788
Brandy (rectified) - -	0.837	Tin (block) -	7.291
Spirits (proof) - -	0.902	Zinc - -	6.861
Alcohol, - - -	0.829	Italian marble,	2.716
Ether (sulphuric) - -	0.739	Lignum vitæ,	1.333
Naphtha, - - -	0.708	Box-wood, -	1.328
Spirit of turpentine, -	0.869	Shell-bark hickory,	1.000
Linseed oil, - - -	0.940	White oak, -	0.855
Sweet oil, - - -	0.915	Red oak, -	0.728
Mercury, - -	13.568	White pine, -	0.418

In the above table, if water be reckoned as 1, the right hand figures become decimal fractions; but if water be called 1000, fractions are avoided, and the specific gravities become whole numbers. Thus a measure which would hold a thousand ounces of water, would be filled by eight hundred and twenty-nine ounces of alcohol, or by thirteen thousand, five hundred and sixty-eight ounces of mercury.

Were a person to obtain a bottle containing exactly a *thousand* grains of water, the specific gravity of any other fluid essayed by it, would be that of the number of grains which it weighed, in the same bottle. Or were weights to be made, which should divide the weight of water decimally, into a thousand parts, the absolute weight would be unimportant, as the number of these parts which were equal to the weight of any other fluid, would be the number which would express its specific gravity. Thus, had I a bottle which would contain a quantity of water, equal in weight to 1000 duck shot, (supposed to be exactly alike in weight,) the number of shot by which the same bulk of any other fluid would be weighed, would also represent its specific gravity.

It happens, that a cubic foot of pure water, weighs exactly 1000 ounces avoirdupoise. This coincidence between its weight, and bulk,

furnishes a ready method for ascertaining the absolute weight of a cubic foot, a cubic inch, or any other given bulk of a substance, the specific gravity of which is known. Let the number 1000, represent the specific gravity, and it also represents the weight of a cubic foot of water; then 13568, which is the specific gravity of mercury, is also the weight in ounces, of a cubic foot, and this divided by 1728, the number of cubic inches in a cubic foot, will give the absolute weight, in ounces, of a cubic inch. All the numbers, in the preceding table, may therefore be considered as expressing the weight of a cubic foot of the substances to which they are attached.

What has already been said, will, to a certain extent, have pointed out the application of specific gravity, to practical uses, and a complete detail cannot be attempted. It is not the ascertaining merely the value and purity of spirits, acids, saline solutions, and infusions, which demands a knowledge of their specific gravities; their fitness for use, in numerous processes, in arts and manufactures, can frequently be best judged of, by the same means. The uncertainty which the artisan supposes to be necessarily incident to a particular operation, results from a difference in some of the circumstances attending it, which may be detected, and with which, it is obviously his interest, to become acquainted; among these circumstances, the strength of his infusions, and of other fluids, hold no unimportant place.

In timber of the same kind, those pieces which have the greatest specific gravity, are superior, both in strength and durability, to those which are lighter. The nature and value of minerals may frequently be determined by the same means; so also may gems be distinguished from imitations of them, and the proportions in which metals have combined in forming alloys, may likewise frequently be thus ascertained.

Clear ideas of many familiar occurrences in the operations of nature, depend upon a knowledge of specific gravity. Why some articles float in water, and others sink in it; why balloons rise, and smoke, and other vapours, ascend in the atmosphere, are questions, the replies to which, must be sought in this branch of science; and when found, they will render these effects as simple and obvious, as the ascent of one scale, when that, at the other end of the beam, is more heavily loaded.

On the difference of the objects embraced by Mechanical Philosophy and by Chemistry. By the Editor.

Natural philosophy, taken in its full and proper acceptation, includes both those great divisions of science, which are named at the head of this article; the term Natural Philosophy, is, however, most frequently used as synonymous with Mechanical Philosophy, to the exclusion of Chemistry; this has arisen from the term Natural Philosophy, having been familiarly used, before Chemistry had assumed a place, as a separate branch of science.

The design of the present essay, is to give a distinct and popular

view, of the objects embraced by these departments of knowledge, which, although intimately connected, are also obviously distinguishable from each other. To attain the end proposed, we shall first give a definition of each, and afterwards attempt to render these definitions, clear, by exemplifications. It is only to those who are already acquainted with a science, that its definition, alone, will convey any *definite*, and comprehensive ideas; to other persons, a few well chosen examples, will be of much greater use, and it is for such that we write.

Every change which takes place in the material world, must be accompanied by *motion*; for it is evident, that if all the masses, and all the particles of matter, in the universe, were to retain their respective places, there could be no change, either in the nature, or in the situation, of those bodies of which it is composed. To ascertain the laws of motion, and to account for the changes produced by it, are the objects of both Mechanical Philosophy, and Chemistry, but the kinds of motion of which they take cognizance, differ from each other, and are governed by different laws.

Mechanical Philosophy, is that branch of science which explains the changes in bodies that result from those sensible motions, which take place in *masses* of matter.

Chemistry, is that branch of science which examines into those changes in the *nature* and *composition* of bodies, which result from motion among their *constituent particles*.

By a mechanical force, or power, is intended that by which any portion of matter may be removed from one place to another, but which cannot produce any change in the *nature* of the body. Gravitation, animal strength, and the matter of heat, are among those forces, which are perpetually acting in the operations of nature, and in the machines constructed by man. Cutting, breaking, and grinding, are some of the numerous changes produced by mechanical force: but after they have been carried to the utmost, they effect no change in the *nature* of the substance subjected to their action, although they may alter its shape and size, and remove it from its place. Suppose, for example, a piece of lime to be ground to powder; every particle of this powder, however minute, would still continue to be a particle of lime; yet we know lime to be a compound body; that is, we know that articles of different natures, are combined together to form it; but these articles are so united, that no mechanical force can separate them. The same reasoning would apply to wood, which is composed of several simple ingredients; and in fine to substances, generally.

We have said that the motions which result from mechanical force, take place in *masses* of matter; by the term mass, we mean any sensible portion, however large, or however minute; and even were it supposed to be so small, as not to be a sensible object, yet if it was admitted to consist of two only of the smallest atoms in nature, it would still come under our idea of mass. Thus a mountain of limestone, or a particle of the same rock, so small as to float in the atmosphere in the form of dust, are still bodies of the same nature, differing from

each other in size, alone. The motion in the air by which the dust is wafted from place to place, or that commotion in the interior of the earth by which the mountain may be overthrown, are mechanical forces, and their effects are purely mechanical.

Besides these changes in the size and shape of matter, or in the place, which it occupies, and which we witness in the operations of nature, or see produced by the efforts of art, and are, in either case, effected by forces which we estimate by weight and by velocity, we constantly witness other changes in matter, which it is evident must be governed by different laws, because we find that those laws which guided us in our calculations on mechanical changes, here lend us no aid, when we attempt to apply them; these are changes in the *nature* of a body, and not merely in its form, or place. We frequently see one kind of matter transmuted, as it were, into another, and even sometimes seem to lose its very existence; these are the changes which are denominated chemical, and are the objects of investigation which belong to chemical philosophy.

What we mean by this transmutation, will be evident from a few examples. A bright piece of iron, exposed to the action of air, and of moisture, will gradually lose its metallic lustre; its surface will assume a brown, earthy appearance, which we call rust; by degrees this change will be propagated through the whole substance of the metal, and then it will not only have lost its lustre, but its tenacity will be destroyed, and a slight effort only will be required to reduce it into powder; it is in fact no longer iron, but may as correctly be denominated an earth, as a metal. Motion however must have taken place, or no alteration could have been produced.

From the same ground, nourished by the same water, and acted upon by the same atmosphere, grows a great variety of plants; some nutritious, others poisonous; some sapid and odorous, others tasteless, and without smell, and in fact, notwithstanding their common origin, possessing a contrariety of properties, which might indicate the most entire dissimilarity. It is not in their common origin alone however, that they resemble each other, for notwithstanding the difference of their properties, they are, when subjected to analysis, all found to consist of the same essential ingredients; and when they undergo the vegetable fermentation, and spontaneously decay, they all return again to the state of soil, or manure; which manure, derives no peculiar property from the kind of plants from which it had been obtained. Some substances, we have said, seem to lose their existence; our candles, and the articles used as fuel, justify this remark, in their combustion; and although it may be proved that not a particle of matter is lost, yet our tallow, our coals, and our wood, no longer exist as such, but have changed into *air*, and into *water*, leaving only a small residuum of earthy matter. We might extend our catalogue of examples through all the substances which exist in the world; for if compound, they are liable to decomposition, and if simple, they are capable of uniting with other bodies, and of producing new substances. These changes are all chemical, as indeed, is every change, whether produced naturally, or by art, which cannot be accounted for upon mechanical principles.

Every substance in nature, may, therefore, become an object of investigation, both to the mechanical and the chemical philosopher, and there is but little difficulty in determining to which department of science, any change in matter belongs; or whether a man is engaged in a mechanical or a chemical art. It must be noticed, however, that the mechanical and the chemical powers, in a great number of instances, operate together, and that, consequently, they must both of them be considered, in the explanation of many phenomena.

We will now name a few of those arts which are properly denominated chemical, and we persuade ourselves, that we shall then have said enough to render the distinction which we have been considering, clear to every one.

Brewing, distilling, soap making, colour making, dying, bleaching, calico printing, varnish making, the manufacturing of pottery, glass making, extracting metals from their ores, forming alloys, soldering, plating, gilding on metals, refining, tanning, the making and purifying a vast number of saline bodies, such as common salt, nitre, alum, copperas, blue vitriol, sugar of lead, &c. &c. These are a few of the arts, denominated chemical, because in the practice of them, new substances are produced, differing essentially in their properties from those of the materials employed, and therefore effecting changes not to be explained upon mechanical principles.

We have now entered upon a subject which is no small favourite with us, and to which we have devoted much of our attention. It is probable, therefore, that "The Artisan" will rarely appear without bringing some intelligence relative to chemistry, with a view to render its language, and its facts, accessible to those who have a high interest in becoming familiar with them.

Mr. Marcus Bull has just published a new edition of "Experiments to determine the comparative quantities of heat evolved in the combustion of wood and coal," &c. which appeared in the 5th No. of our first volume. To this new edition are prefixed some valuable preliminary remarks and estimates, which we now present to our readers.

Preliminary Remarks, with observations and estimates, tending to manifest the importance of the subject treated of in the Essay on Fuel, &c.—By Marcus Bull.

From the acknowledged difficulty of obtaining rigid accuracy in researches, having for their object so subtle a principle as caloric; I had anticipated, that objections would probably be made against some part of the apparatus employed in my experiments, tending to invalidate their results.

Notwithstanding the severe examination to which my experiments have been subjected since their publication, the only objection urged against their accuracy, which may be considered as entitled to any

serious attention, is, "that the *surface* of the walls of the *exterior* room, though the air in it be maintained *uniformly at one temperature*, presents for the heat radiated from the surface of the *interior* room, a refrigerating medium of inconstant power; in consequence of the varying temperature of the atmosphere:" or in other words, that, "the *surface* cannot be maintained at the *same temperature* as the *air in contact with it*, during the ordinary changes in the temperature of the atmosphere." This objection I have recently subjected to the most rigid, and delicate test; and that at a period when the difference in the temperature of the atmosphere, and that of the room, was double in amount to any which occurred during my course of experiments; using instruments, similar to those which have been employed, to detect the existence of heat in the rays of the Moon, and with similar results, as to amount, there being no appreciable inconstancy discoverable in the refrigerating medium. These experiments were performed in the presence of a number of scientific gentlemen, who will, if necessary, corroborate the accuracy of this statement.

To place the subject treated of in the following pages, in a more popular, and striking point of view, I have recently ascertained with as much accuracy as was practicable, the quantity and value of the different kinds of fuel, already brought to Philadelphia, to supply its consumption in domestic economy, and for all other purposes, from March, 1826, to March, 1827. The quantity of wood was ascertained from the official returns made to the City Treasurer, by the corders, upon the public landings, and also from the private accounts, and estimates of the corders upon all the other landings in the City and Liberties. The quantity of foreign coal was obtained from the Custom House books, and that of the remaining coals, from the most authentic sources within my reach.

Estimate of Wood and Coals, required for the consumption of Philadelphia, from March, 1826, to March, 1827.

			D.	C.	
140,150	cords of	Wood, average price - - - -	4	50	630,675.
25,545	tons of	Lehigh and Schuylkill coal* at -	7	00	178,815.
320,000	bushels of	Pine Charcoal - - - - -		10	32,000.
95,000	do.	of Richmond Coal - - - - -		30	28,500.
30,465	do.	of Liverpool Coal - - - -		33	10,053.45
					$880,043,45

The population of the City and Liberties of Philadelphia, at the present time, may be estimated at 125,000.† By dividing the whole cost of fuel (880,043.45) by the number of inhabitants (125,000) we obtain $7.04 as the average cost of fuel for each inhabitant, supposing the consumption to be equal; but as this is not the case, it is not

* The whole quantity of coal sent from these mines to Philadelphia in 1826, was 47,545 tons, of which 22,000 tons were sent abroad.

† The population of the city and liberties, by the census for 1810, was 92,247, and for 1820, 108,116.

my intention to apply this calculation individually, but to large portions of the community. Supposing each article to be sold at its true comparative value, we may infer, from the foregoing calculation, that the quantity of fuel required in Philadelphia, for every purpose, would be nearly supplied by 125,000 tons of Lehigh or Schuylkill coal, or one ton for each inhabitant.* If we look prospectively to the early period, when these coals may be expected to be furnished at $5 per ton, their substitution for other kinds of fuel, in all cases where it is practicable, will become a matter of general interest.

The climate of Philadelphia is, perhaps, a fair average of that portion of the Atlantic States, from Maine to Georgia. If we suppose that its consumption and prices for fuel, are also fair averages, for the inhabitants residing in those States, near tide water, we may extend our calculations with some degree of accuracy, beyond our own fire-sides.

From the Census of the United States for 1820, we find that the whole population was 9,638,226, and that the Atlantic States from Maine to Georgia, both inclusive, contained 7,151,959, of which number about 2,500,000 resided within ten miles of tide water. The same district of country may now be supposed to contain 3,000,000 of inhabitants,† which, multiplied by the cost of fuel for each inhabitant of Philadelphia, (say 7 dollars,) we obtain 21 millions of dollars, as the cost of fuel for these inhabitants, for one year. This portion of the United States, will, it is presumed, at no very distant period of time, be principally supplied with fuel from the coal mines of Pennsylvania, and at an estimate of one half the required quantity, will consume 1,500,000 tons, annually: which, at $5, will amount to $7,500,000.

If we suppose the United States to have increased 20 per cent. since 1820, they contain at the present time 11,565,871 inhabitants, and if we estimate the cost of fuel for the remaining 8,565,871, at $3 50 for each person, these numbers being multiplied by each other, we obtain $29,980,548, which being added to the 21,000,000 as the cost for the 3 millions before stated, we have an aggregate cost of $50,980,548 for the fuel consumed in the United States, for all purposes, during one year.

The following statement of the consumption of fuel in London, and its environs, for one year, is made for the purpose of comparing it with the consumption of Philadelphia, in the proportion of their respective population.

From an official account, it appears, that there were imported into

* These coals, as brought to market, are probably of the same value in equal weights, although a slight variation was found in my results, from the specimens experimented upon.

† I find by calculation from the enumerations in 1790, 1800, 1810, and 1820, that the rate of increase between those periods, was as follows. From 1790 to 1800, 35 per cent., 1800 to 1810, 36.4 per cent., 1810 to 1820, 33.1 per cent.; at which latter rate from 1820 to 1826 inclusive, gives 19.8 per cent., say 20 per cent., or an increase of 500,000 inhabitants in 2,500,000, making an aggregate of 3,000,000 as above stated.

London during the year 1824, 1,505,021 chaldrons of coal, to supply the consumption of London and its environs, which, at that time, were estimated to contain 1,500,000 inhabitants. This quantity gives very nearly one chaldron, or 36 bushels, of Newcastle coals (average cost 48 shillings, or $10.67) for each person; and the quantity of heat evolved from the combustion of which, is only equal to that from 20 bushels of Lehigh coal. Now we find that in Philadelphia about one ton, or 28 bushels of Lehigh coal, may be estimated to be required for each person; the proportion therefore between the two places for each inhabitant, in quantity, is as 20 to 28, and in cost, as 10.67 to 7.04. The discrepance in the quantity, may be attributed to the milder climate of London during the winter season, and to the greater frugality of its inhabitants, in the use of fuel, both in the arts, and in domestic economy.

Philadelphia, January 1, 1827.

The following notice is extracted from Professor Silliman's Journal, Vol. xi. No. 1. p. 98.

I have been just favoured with a copy of a Memoir, by Mr. Marcus Bull, read before the American Philosophical Society of Philadelphia, April 7, 1826—entitled:

"*Experiments to determine the comparative quantities of Heat, evolved in the combustion of the principal varieties of wood and coal, used in the United States for Fuel; and also to determine the comparative quantities of Heat lost by the ordinary apparatus made use of for their combustion.*"

This memoir is the result of a long course of experiments, evidently conducted with great care and skill. It is replete with interesting information, and is to be regarded as one of the most important contributions of science to the arts and to domestic economy, which has been made for a long time in this country. It is worthy of being carefully studied, both by scientific and practical men, and for the sake of the latter class, it might be well if an analysis of this elaborate and detailed paper, presenting, in a lucid and concise form, the practical important results which have been obtained by Mr. Bull—were prepared for extensive circulation.

FROM THE GLASGOW MECHANICS' MAGAZINE.

ESSAYS ON MATHEMATICS.

By the late Mr. John Cross, *Teacher of Mathematics, Glasgow.*

No. I.

The word mathematics originally signified discipline or learning, (science;) but it is now appropriated to that science which teaches the comparison and mensuration of magnitude. It has also been termed the science of quantity, and in this view, the objects to which

it may be applied are equally numerous and various as the objects of our senses; for whatever is the object of our senses, is capable of being considered, either with respect to its number, its extension, or its quantity.

Mathematics are divided into *pure* and *mixed.*

Pure mathematics considers magnitudes generally, simply, and abstractedly, without any relation to matter or sensible objects.—Under this class are comprehended,

1, Arithmetic, or the art of numerical computation;

2, Geometry, which teaches us to measure extension;

3, Analysis, or the comparison and calculation of magnitudes in general;

4, Mixed geometry, or the combination of geometry with analysis.

Mixed mathematics borrow from physics, that is natural philosophy, one or more incontestable experiments, and then, by a demonstrative chain of reasoning, they deduce, from established principles, conclusions as certain as those of pure mathematics.—Under this division are comprehended,

1, Mechanics, the science which treats of the effect of moving powers, or forces, and the laws of motion;

2, Hydrodynamics, which explains the motion of fluids, and the laws of their action;

3, Astronomy, which considers the revolutions and various phenomena of the sun, moon, and other heavenly bodies;

4, Optics, the science of vision, including the properties of light and colours;

5, Acoustics, the theory of sounds.

Mathematics have also been divided into speculative and practical; a division which applies both to the pure and mixed.

Speculative mathematics inquires after knowledge which it is proposed to attain, and simply contemplates the truth or falsehood of what is asserted.

Practical mathematics is the application of the speculative, and shows how to perform something useful or advantageous to mankind.

It is not possible to fix the origin of mathematics with precision, though we are able to affirm that it goes back to the remotest ages. Josephus asserts that they were studied before the flood; that the sons of Seth were observers of the heavens; that they built two pillars, the one of brick, the other of stone, to commemorate their discoveries, and that Abraham taught these sciences to the Egyptians, who, however, there is reason to suppose, were acquainted with the science previous to the period of the Patriarch's sojournment among them. The most certain and best established opinion is, that the mathematics began to acquire a certain solidity almost at the same period among the Chaldeans and Egyptians, the two most ancient people known in history.

The magi, or priests of Egypt, directed by the laws of their institution to study and collect the secrets of nature, were become the depositaries and dispensers of all human knowledge; but they have been blamed with involving their discoveries in mystery. It is said

that Thales travelled into Egypt about 600 years before Christ, and brought the mathematical sciences into Greece; and, whether this be true or not, it is only from this time that we have any certain accounts of them.

With the mathematics of the ancients we are acquainted only through the writings of the Greeks, and we do not possess the necessary documents to estimate the instruction which these derived from their intercourse with the more eastern nations. We know, however, that as soon as the mathematics took root in Greece, their progress was rapid, and the Grecians became, in some measure, the preceptors of all nations. The elementary books collected and arranged by Euclid, have been translated into all languages, and have continued for more than 2000 years to be exclusively taught in every mathematical school—a certain proof of their excellence. The conics of Apollonius hold an equal rank in what has been called the higher geometry. Many other mathematicians laboured in the same field, but the most exalted rank in this legion of honour has been assigned, both by reason and fable, to the sublime genius of Archimedes.

In the accurate sciences which require cool attention, silence, and profound meditation, the Romans never surpassed mediocrity. Useless as the means of attaining the first offices of the state, they were the occupation of a few obscure individuals, remote from the agitation of public affairs. The Roman mathematicians were little more than translators or commentators of Archimedes, Apollonius, &c.

On the death of Theodosius, and the division of the empire, the western part was long ravaged, and at length subjugated by barbarians, and soon sunk into profound ignorance; while the eastern schools were wholly employed in theological disputes. The accurate sciences had taken refuge in the Alexandrian museum, (almost the only refuge they had left them,) which was founded by Ptolemy Philadelphus, about 320 years before Christ. Here the mathematics flourished near ten centuries. But of this asylum they were deprived about the middle of the seventh century, when the Arabs, conducted by the successors of Mohammed, spread carnage and devastation through the east, the museum and library of Alexandria were destroyed.

However, though the chain of mathematical discovery was broken by this fatal catastrophe, a few links remained, which this nation of destroyers, softened by the charms of peace, strove to collect and unite afresh. In less than a century we find the Arabs cultivating astronomy, and their taste for a particular science gradually extended to all the branches of knowledge. For the space of seven hundred years, the mathematics flourished in the extensive dominions of the caliphs; by the Moors they were carried into Spain, and spread over the rest of Europe. And the Arabs rendered essential service by their translations of the works of the ancient Greeks, with some of which we are acquainted, only through the medium of the Arabic version.

The conquests of the Turks brought back ignorance and barbarism, on the delightful countries which the Arabs inhabited; and extin-

guished the lamp of science which had long glimmered with fading lustre in the dissolute and desolated provinces of the eastern empire. At the taking of Constantinople by Mohammed II. a persecution arose against artists and men of learning, by which many of them were destroyed; but some escaped, and carried with them the remains of the mathematical sciences into Italy, France, Germany, and England, countries in which a taste for literature had already begun to take root.

From this period, all the branches of the mathematics made rapid progress. The improvements of the moderns have put us in possession of an infinite number of problems, inaccessible to the ancient geometricians. The ancients have given us nearly the whole of what has been termed pure or speculative geometry, few additions have been made to the fundamentals of the science—most of the modern works on plane geometry, or the conic sections, are compilations from theirs; but the moderns have improved arithmetic. The ancients knew little, if any thing of algebra, and we claim the sublime invention of fluxions as our own. We have applied the mathematics to the improvement of practical arts and sciences, as mechanics, projectiles, gunnery, astronomy, and optics, far more extensively than they; and they were ignorant of the combination of analysis and geometry which we employ.

But let it not be supposed that the moderns have surpassed the ancients in genius. It is probable that the discoveries which they made, required, in the infancy of science, intellectual exertions as great as any modern improvement. The most important improvements in science have always been preceded by gradual advances. The discovery which astonishes when it is announced, can often be traced through many previous steps which all contribute to bring it to light; and the wonder that it should not have been sooner made, is often greater than the surprise which it occasions.

We are possessed of instruments, which are equally just, which arrive, by a shorter process, at the end proposed; but we are inferior to the ancients in pure geometry. If Archimedes were to return to this earth, with all the wonderful attainments he possessed, he would be obliged to subject himself to a long course of study before he could place himself on a level with Newton; yet Newton lamented that he had too much neglected the strict geometrical reasonings of the Syracusan sage.

On the coral reefs and islands of Australasia and Polynesia.

Throughout the whole range of the Polynesian and Australasian Islands, there is scarcely a league of sea unoccupied by a coral reef, or a coral island; the former springing up to the surface of the water, perpendicularly from the fathomless bottom, "deeper than did ever plummet sound," and the latter in various stages, from the low and naked rock, with the water rippling over it, to an uninterrupted forest

of tall trees. "I have seen," says Dalrymple, in his Inquiry into the Formation of Islands, "the coral banks in all their stages; some in deep water; others with a few rocks appearing above the surface; some just formed into islands, without the least appearance of vegetation; others with a few weeds on the highest part; and lastly, such as are covered with large timber, with a bottomless sea, at a pistol-shot distance." In fact, as soon as the edge of the reef is high enough to lay hold of the floating sea-wreck, or for a bird to perch upon, the island may be said to commence. The dung of birds, feathers, wreck of all kinds, cocoa-nuts floating with the young plant out of the shell, are the first rudiments of the new island. With islands thus formed, and others in the several stages of their progressive creation, Torres' Strait is nearly choked up; and Captain Flinders mentions one island in it covered with the *Casuarina*, and a variety of other trees and shrubs, which give food to paroquets, pigeons, and other birds, to whose ancestors, it is probable, the island was originally indebted for this vegetation. The time will come—it may be ten thousand, or ten millions of years, but come it must—when New Holland, and New Guinea, and all the little groups of islets, and reefs, to the north, and north-west of them, will either be united into one great continent, or be separated only with deep channels, in which the strength and velocity of the tide may obstruct the silent and unobserved agency of these insignificant, but most efficacious labourers.

A barrier reef of coral runs along the whole of the eastern coast of New Holland, "among which," says Captain Flinders, "we sought fourteen days, and sailed more than 500 miles, before a passage could be found through them out to sea." Captain Flinders paid some attention to the structure of these reefs, on one of which he suffered shipwreck. Having landed on one of these new creations, he says, "we had wheat-sheaves, mushrooms, stag's horns, cabbage leaves, and a variety of other forms, glowing under water, with vivid tints of every shade betwixt green, purple, brown and white." "It seems to me," he adds, "that when the animalcules, which form the coral at the bottom of the ocean, cease to live, their structures adhere to each other, by virtue, either of the glutinous remains within, or of some property in salt water; and the interstices being gradually filled up with sand and broken pieces of coral washed by the sea, which also adhere, a mass of rock is at length formed. Future races of these animalcules erect their habitations upon the rising bank, and die in their turn, to increase, but principally to elevate this monument of their wonderful labours." He says that they not only work perpendicularly, but that this barrier wall is the highest part, and generally exposed to the open sea, and that the infant colonies find shelter within it. A bank is thus gradually formed, which is not long in being visited by sea-birds; salt-plants take root upon it, and a soil begins to be formed; a cocoa-nut, or the drupe of a pandanus, is thrown on shore: land-birds visit it, and deposit the seeds of shrubs and trees; every high tide and gale of wind add something to the bank; the form of an island is gradually assumed, and last of all, comes man to take possession.

If we should imagine one of these immense coral reefs to be lifted up by a sub-marine volcano, and converted into an insular, or continental ridge of hills, such a ridge would exhibit most of the phenomena that are met with in hills of lime-stone.—*Glasgow Mech. Mag.*

Hints to Paviers. By Colonel F. Macironi.

In our 137th number, we gave a brief account of a plan, by Colonel Macironi, for improving the pavement of London, (as well as other cities,) by means of pressure applied in three different stages of the work; first, to harden the ground previously to laying the stones; second, to fix and depress them when laid; thirdly, to equalize and perfect a pavement after it has been some time in use, by applying the pressure only on the protuberant parts. We have since been favoured, by Col. M., with a copy of the pamphlet, from which that account was taken; and as only a few copies of the same were printed, for private distribution, we feel happy in having obtained the author's permission to reprint, for the use of our readers, all that part of it which was not included in our former extract. It will be found to contain much useful information, and sensible remark.

[*Editor London Mech. Mag.*

"However true it may be, that an observant traveller cannot fail of being struck with admiration at the excellence of the turnpike and other roads throughout this country, he must, at the same time, be very much surprised at the badness of the *carriage pavement*, even of the principal streets of this astonishing metropolis. It is difficult for him to understand how, in a country where every mechanical art is best understood and actually applied to the most useful purposes—where ingenuity, guided by science, is ever on the research, and ever sure to be rewarded for each fresh improvement—how, in the very capital of such a country, the carriage pavement should be, perhaps, worse than that of any other metropolis in Europe? It is, to be sure, justly boasted, that this city enjoys the advantage of commodious and matchless foot-paths, and that the existence and goodness of such foot-paths is, in one point of view, of more general convenience and personal comfort, than that of a perfectly level and easy carriage pavement, inasmuch as the safety and convenience of the thousands who walk,* should be preferred to that of the dozens who ride

* It appears somewhat surprising and anomalous, that in this most aristocratic of all countries, so much attention should have been bestowed on the construction of footpaths. In monarchical France, no such accommodation was ever thought necessary for the "*canaille*," who, consequently, are left to scramble out their way in the mud, amongst the carriages, and under the hoofs of "their excellencies'" horses.

Even at Bagdad, Aleppo, and Damascus, there are commodious footpaths to a considerable distance beyond the suburbs!

in their carriages. But, in a city like this, teeming with life and activity, throughout which so many thousand public conveyances perpetually travel at so rapid a rate, the state of the *carriage pavement* must surely be a matter of very great importance.

Previously to pointing out what I conceive to be the most advantageous method of improving the carriage pavement of London, I think it will be expedient to offer a few observations on the nature and construction of such pavements on the continent, as are most remarkable for their excellence and durability.

The ancient Roman paved roads, such as the Via Appia, the Sabina, the Flaminian, Emilian, &c. &c., first claim our attention. Of these, there are still tracts of many miles in perfect repair in southern Italy, especially in the neighbourhood of Rome. A good foundation of gravel, broken limestone, or of basalt, was sometimes applied, where the nature of the soil required it. It is unnecessary to mention the causeways of solid masonry over which they were at times carried, as such causeways, in certain situations, were as indispensable as they would be at the present day under the same circumstances of locality.

The stones composing the pavement of these roads are uniformly of basalt,* of a polyangular shape, containing, on an average, about four or five feet surface, and about twelve or fourteen inches in depth or thickness. They are generally more or less slightly pyramidical, and placed with the base or broadest surface uppermost.† It is by no means in every instance, as is asserted, that these stones are laid in a bed of mortar; in many situations I have found it otherwise.‡ Neither are their edges chipped with any great nicety; the juxta-position is, however, well contrived, and indeed very remarkable; for although they vary *ad infinitum* in shape, angles, and more or less in size, they are fixed together as though each had been expressly cut for its situation.

It would appear, that in many places large tracts of these roads have been intentionally destroyed, either for the sake of the materials, or for the purposes of war and devastation; other portions have, in the lapse of ages, disappeared with the gradual changes to which the surface of this earth is subject, especially in inhabited districts,

* The preference for basalt was so decided, that where the roads, for instance, traverse the Appenines, composed of marble and the hardest limestone, basalt has still been used, though it must have been conveyed thither at a great expense. In some instances, however, I have observed a single line of large marble or limestone blocks applied as an edging or "curb" to the basalt.

I am inclined to believe, that this exclusive use of basalt is attributable to its being, although harder, less slippery than marble or limestone. I have particularly remarked in the town of Caserta, where some of the streets are paved with limestone, and the rest with basalt, that the former alone are most inconveniently and dangerously slippery, although both kinds of stone are cut and laid in a similar manner.

† I should, however, recommend the upper and lower surfaces to be equal.

‡ In most cases no more mortar was used than was sufficient to fill up the interstices, which, from the shape of the stones, were wider below than at the surface.

when barbarism rapidly succeeds civilization, or civilization, barbarism. Such portions, however, as have been left to contend with the mere wear and use for which they were constructed, some two thousand years ago, are in as good order and preservation as ever.

The pavements, most similar in construction and solidity to the ancient Roman, are the modern Neapolitan. The stones of these are also of basalt; but, in lieu of being polyangular, they are rectangular quadrangles, mostly squares, generally of about four feet surface, and six inches in thickness. The sides are very accurately wrought, as well as the surface, which is left as rough as is consistent with a good level. These stones are laid in a thick bed of the best Puzzolana mortar, and always so arranged that the lines of junction are never parallel with the line of road, but cross it diagonally. This pavement excels in evenness and level; is very permanent, but expensive, and liable to become dangerously smooth, which renders it necessary, from time to time, to cut grooves on its surface. The city of Naples being admirably provided with sewers and sub-ways of the most solid construction, the necessity for disturbing the pavement very seldom occurs, so that the expense, though great, is pretty much confined to the first laying.

The pavement of modern Rome is also of basalt. The stones are parallelograms of about two cubes in length; and on being set up endways, they present about ten inches square surface. Although they are accurately cut, and equal in size, they are simply fashioned by a few skilful blows of the hammer. More mortar is used in the construction of these pavements than even in the Neapolitan. I have observed the bed of the best Puzzolana mortar, on which they are laid, to be above a foot thick.* Rome being provided with the most extensive and complete sewers and sub-ways of any city in the world, its pavement, or, as it may be called, this horizontal wall, has likewise very seldom any occasion to be disturbed.†

I believe it will be found that the level of most cities has a tendency to a gradual rise; as more materials are introduced into them than are ever taken out again. The numerous sackings, burnings, and subversions endured by Rome in the barbarous wars of the lower empire, and the "good old times" that followed, have produced a considerable rise in its level. This has necessarily been greater in the lower parts between the celebrated seven hills, whose relative elevations have diminished proportionately. Thus the famed Tar-

* When the Roman or Neapolitan pavement is fresh laid, care is taken to cover it a foot deep with earth or rubbish, to protect the mortar, until it is set, from the jars of the carriages.

† At present there are in Rome but few streets which exhibit the ancient polyangular pavement. In most parts of the city it lays at the depth of from eight to twelve feet beneath the present surface. The accumulation over the whole extent of the Forum Trajanum, which was cleared away by the French in 1813, was, on an average, about twelve feet. That over the Forum Romanum, situated between the Mons Capitolanus and Mons Aventinum, was still greater.

peian rock, or precipice, on the south side of the capitol, has by the process of subtraction from the top, and addition to the bottom, during more than two thousand years, been reduced to less than forty feet in height.

[TO BE CONTINUED.]

FURTHER HINTS TO PAVIERS.

The following is the extract from Colonel Macirone's pamphlet, published in the Mechanics' Magazine, and to which reference is made at the beginning of the preceding article.

My expedient is pressure, which may be applied in three different stages of the work; first, to harden the ground previously to laying the stones; secondly, to fix and depress them when laid; thirdly, to equalize and perfect a pavement after it has been some time in use, by applying the pressure only on the protuberant parts.

The machine I propose for the above purpose is similar to a pile-driver of the lesser kind; the weight being drawn up by a rope passing over a single pulley wheel at the top of the slide shafts, and terminating on the other side, in a cluster of smaller ropes or cords, one for each of the six, eight, or ten men employed to work the machine. The weight, or "monkey," as I believe it is called, is raised by simultaneous hauls of the men, and let fall again by similar alternating movements of relaxation. For my purpose, the weight should be of wood, more or less conical, with a flat circular base of about three feet diameter. A solid block of oak, well bound and shod with wrought iron, and weighing about 5 cwt. would produce sufficient force with very little raising, consequently with much rapidity, and be at the same time perfectly manageable. The perpendicular slide shaft and stays, together with the weight, that is to say, the whole of this simple machine, is to be fixed upon a quadrangular frame of about eight feet by five; and to this frame I would attach four or six pivot or castor wheels, of about a foot diameter, by which it might be moved with the greatest ease in every possible direction. If the men who work the weight are made to stand upon the frame itself, it may he worked uninterruptedly, while it is regularly drawn over the pavement, faster or slower, repeating or not repeating the blow on the same spot, according to the intention and discretion of the superintendent.

It surely must be allowed, that the present method of simply digging up the ground to a considerable depth with a pickaxe, without any subsequent hardening, can but furnish the stones with a foundation of very unequal resistance. It is true, that, after laying them in this soft bed, they are slightly compressed with a hand rammer; but it is obvious, that unless this compression be made equal to that which the stones will afterwards have to endure from carts, &c. the surface of the pavement must speedily give way, and become the counterpart

of the unequally dense substratum. Even were the subjacent earth quite uniform in its density, or rather, I should say, in its softness, it is absurd to expect the pavement can preserve its level, when that density is so far from being sufficient to resist the maximum of pressure it is destined subsequently to endure. Were this subsequent pressure equally distributed, and applied to every stone, we might then expect the whole surface to sink together; but as this can never be the case, inequality of pressure will speedily produce inequalities of the surface, which must increase in a rapid geometrical ratio. To establish a permanently level pavement with the materials we are speaking of, I do not say that the subjacent earth must be of a perfectly homogeneous density; it is sufficient that it be so compressed, either before or after laying the stones, or both before and after, that its parts of minimum density be able to resist the maximum of the pressure it will be subsequently liable to. In laying a new pavement, I should advise, first, moderately to compress the earth, and afterwards repeat the ramming on the stones; by which division of the operation a degree of density will be obtained, with the application of much less power than would be required to produce the same by only one application on the surface of the pavement. If at this period the proper quantum of compression has been given, there is no fear of any inequalities being formed by the action of the heaviest vehicles; but I should not think it requisite to give a similar density to the pavement in every street, there being many through which a vehicle heavier than a coach is seldom, if ever, known to pass.

In cases where a street has been already paved in the usual way, and when, as is usual in a few days, it has begun to assume its wonted picturesque unevenness of surface, it may be rendered perfectly and permanently level, without the expense of taking up the stones, by the careful application of the machine I recommend. But the operation must not be too long delayed, for inequalities once formed, must necessarily increase with accelerated rapidity, inasmuch as the wheels continue to fall into the depressions with a momentum, which progressively increases with the increase of the depressions. An early obliteration of the protuberances will put a stop to the evil, and a permanent density be established.

The exact state of the surface of the pavement is rendered remarkably evident and definable when water is thrown upon it; which I have had particular occasion to remark, when it has been applied abundantly to lay the dust. This I would make auxiliary to the after-compressing operation I am now speaking of. The water-throwers should precede the machine, and certain men, with a good and careful eye, might mark the projecting stones with chalk, as a further guide to the action of the compressor. It is also probable that the water would, more or less, diminish the friction of the stones against each other, and facilitate their descent. I have frequently observed, that nearly one half of Piccadilly might be levelled in this manner, without the necessity of taking up a stone, except in a very few places, where extraordinary depressions have been formed. I

do not, however, wish to establish the utility of the method I propose, on the merits of this second-hand application of it, but mainly upon its application under and upon the stones, at the time of laying them. Nothing else will produce a level and permanent pavement with the materials at present in use, and consequently without increase of expense. With regard to the improvement of these materials, it is certain that the more exactly the stones are cut, the better; but this I apprehend must be regulated by the prescribed latitude of expense: it would be well to take off their convexity, by a few good chips from the top or crown of the stones that are much worn. But let them be wrought with the most mathematical nicety, it will avail nothing in the end, if they are laid according to the soft, uncompressed method of the London paviers. If we would have an even pavement, we must either have recourse to the deep beds of cement, or the huge stones I have described in the beginning of this article, with all their expensiveness and other inconveniences; or we must apply to the method and materials already in use, the only process which will remedy their evident defects, and produce the wished-for result. As to the earth in which the stones are laid, I should prefer a mixture of broken gravel, dry rubbish, and a little chalk; but this arrangement also, must depend on the expense. The quantity of oxide and carburet of iron which forms under the pavement, produces a strong tendency in the subjacent mass to indurate and agglomerate, which would be very greatly accelerated by the pressure I recommend.

It now only remains for me to refer to the principal, or only, objection which I can anticipate, might be made to the use of my machine; which is, the supposed injury it might occasion to the gas and water pipes. It will be very easy to prove in half an hour, by experiment, that no such injury can occur. Cast iron pipes, at the depth of two feet, would not sustain any injury from the utmost efforts of the engine, especially if any care had been taken to lay the finer portion of the earth or gravel in immediate contact with them. But this precaution, I affirm, will be by no means necessary, if the pipes are from two to three feet from the surface, which surely is not an unreasonable depth.

On the Management of the Bellows, Tuyeres, and Fuel, in Smiths' Forges.—By Thomas Gill, Esq.

We have already treated at some length on these important subjects, still, however, much remains to be said thereon, and we shall accordingly continue to add, from time to time, such additional facts as may come to our knowledge.

We mentioned (see Vol. II. page 59) that Mr. Duncan Campbell uses a wider aperture to his bellows and tuyere than is usual, and that his tuyere is an inch in diameter, and widens towards the forge fire; to this we may add that he has fitted other tubes to his tuyere, by which he can occasionally contract its bore, according to the kind

of work he is employed upon; thus, for small work, as nails for instance, he contracts it to a bore of only half an inch, and has also an additional tube of three quarters of an inch in diameter.

He was much perplexed lately, at being unable to excite his fire with his usual readiness, in order to heat an article of some bulk, and long laboured at his bellows with all his might, but in vain; at last he recollected, that in making some nails he had contracted the tuyere to half an inch only, and accordingly he removed the contracting tube, and widened it to an inch, when he readily brought his heat up.

Mr. E. Hazard informed us lately, that in employing the *Anthracite*, or stone-coal, in the United States, as fuel in smiths' forges, it is necessary to increase the bore of their tuyeres to an inch and a quarter in diameter, when there is no difficulty in using it. This information may prove the means of enabling us to bring *the immense beds of anthracite in South Wales* more generally into use.

Mr. W. Mason confirms the superior efficacy of *wide bellows-pipes and tuyeres*, in heating large masses of iron or steel in forge-fires. He has used them so large as *an inch and a half in diameter*, and with the most beneficial effect, in quickly bringing his axle-trees, &c. to a welding heat all through, without, as usual, burning away their exterior surfaces. Neither is the *striker* who blows the bellows so much exhausted, by the great labour of working them to bring up his heats, as to nearly unfit him for exerting his strength with the hammer, as is commonly the case; on the contrary, the bellows with wide nozzles and tuyeres, are worked with much greater ease, than those with the usual narrower ones. There will indeed, be some difference found, in *the heats being brought up much quicker with the wide tuyeres;* but that, surely, can be no objection, either to an industrious workman or his employer.

Mr. Mason informed us, that he was much pleased to witness lately, the superior management of his fire, by *a twisted gun-barrel forger*. He spread a considerable quantity of fresh *Staffordshire coal* over the whole extent of his hearth, having previously broken it into small lumps; and so contrived it, that he always reduced it to the state of *coke* or *cinder*, before it formed his forge-fire; thus producing its best effects, in heating the barrels to a welding heat. He was continually bringing fresh coal gradually forwards towards the fire, so as, by degrees, to consume the bituminous parts of it, and finally convert it to the state of coke.

In the use of *sea-coal*, or that which possesses a *caking* or *binding property*, owing to the excess of bitumen it contains, and which admirably fits it to form *hollow-fires*, Mr. Mason states, that it is absolutely necessary to feed those hollow-fires with such coal, previously reduced to the state of coke or cinder; as, otherwise, great injury is produced in the fire, from the sulphur and bitumen contained in the coal.

The following accident occurred, owing to the want of attention, or of the requisite knowledge, in a smith at Cambridge, who was lately repairing an axle-tree. Mr. Mason, to whom it belonged, had not

turned his back, to speak to another person, above a minute or two, before he heard a violent hissing noise, and found that the smith had nearly burnt the axle in two.

No doubt the bellows-pipe, and tuyere, of his forge, were both of them too small; or else this accident would hardly have occurred. The blast being always *much sharper* from such causes, and acting *partially* upon the bodies to be heated by it. [*Tech. Repos.*

On preserving Turnips and their tops, as winter food for Sheep and Cattle. By the Rev. T. C. MUNNINGS. *Extracted from the Transactions of the Society for the encouragement of Arts, Manufactures, and Commerce.*

It has long been considered, by those who are engaged in farming, as a material desideratum, to defend and secure turnips from that host of foes with which they have to contend, and more particularly to preserve them from the injurious effects of frost, in order to receive the full benefit of them as winter and spring food for sheep and oxen.

Dr. Martyn indeed mentions some methods which have been pursued for the attainment of such an end; but as none of them have been admitted into very extensive practice, it may be presumed that they have been abandoned, on account of the difficulty of executing the prescribed work; on account of the expense attending it; or on account of its being inefficacious.

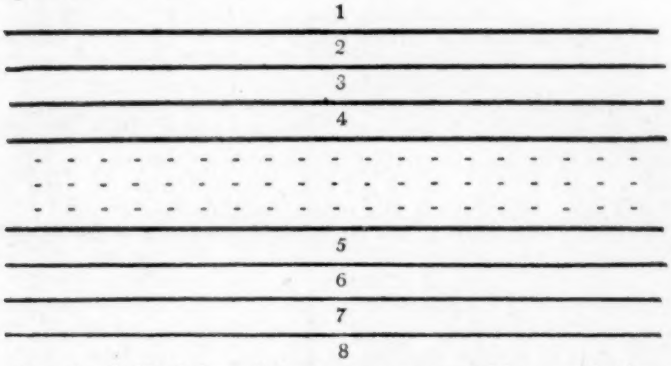
It has *twice* been my lot to be most flatteringly noticed by the society, for my successful efforts in the cultivation, and for the protection and preservation of turnips during the winter months; it is my earnest wish to give as succinct, but at the same time as clear an account as I can of my experiments for such purposes.

It must be understood, in the first place, that my turnips are *drilled* at the distance of alternate furrows, that my ridges are set out precisely the width of fifteen feet, and that each ridge contains exactly eight rows of turnips. This being the case, I have at various times within the last four years made use of the following methods of *preserving turnips during winter months.*

The first and most simple which I shall mention, was only with a narrow-set double-breasted plough, drawn by one horse, to plough between the rows, and throw earth each way upon the apples of the growing turnips. The advantages of this mode were, a partial ploughing of the land in the early part of the winter, and a preservation (almost perfect) of the turnips for spring consumption.

The second mode which I next invented (I say next invented, because the first mode differs from the Northumberland practice only in the circumstances of my turnips growing upon a flat surface, instead of the tops of two furrow work, and therefore more easily defended with a plough) was first executed by casting away the alternate rows for autumnal consumption; thus leaving rows somewhat

more than a yard asunder, and then with a one-horse single-breasted plough moulding up the same; thus giving to the land the appearance of what is called Tops and Balks; each top embracing and defending a row of turnips, and the balks being in the lines from whence the turnips were removed. I look upon the advantages of this plan derived from such seasonable ploughing to be similar to those in the first-mentioned mode; but as the turnips are covered with a greater body of earth, the preservation of them is so much the more perfect, because the frost must be more intense before it affects them, and, in case of a thaw, is discharged from them more gradually. The third mode may easily be conceived, by the following supposition. Let the lines 1, 2, 3, &c. represent the eight rows of turnips growing upon a ridge, eight being the most convenient number of rows for the easy execution of the work.



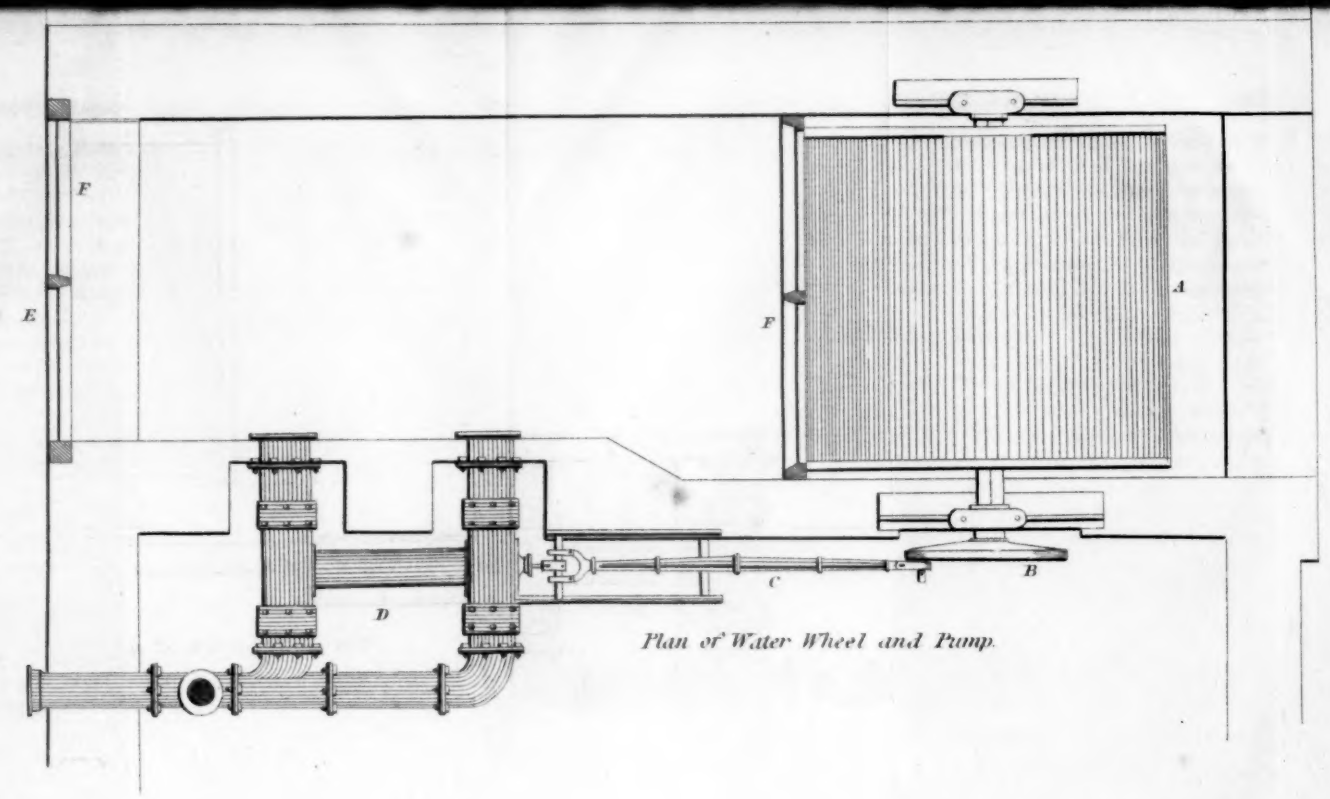
Conceive half of these lines to be upon one ridge, and half upon another; in that case, there will be a furrow between 4 and 5. This furrow is to be opened with a double-breasted plough (drawn by one horse), which will raise mould for the protection of what I will call the insides of the two rows 4 and 5; the rows 1, 2, 3 were then to be pulled by one man or woman, and put into the opened furrow between 4 and 5, with their tops inclined towards 4. In the same manner the rows 6, 7, 8 are to be pulled by another man or woman, and put into the same furrow, with their tops inclined towards 5. Two or three furrows are then to be ploughed, with a one-horse foot plough, to the outsides of the rows 4 and 5, and some mould from the third furrow so ploughed, shovelled into the apples, and part of the tops of the collected rows; (of this shovelling I think, from what I have done, that a good labourer will finish two acres in three days) and the ploughing may be then carried on so as to give the land almost a complete earth.

Of this plan the advantages are so evident as scarcely to need explanation. Those derived from the ploughing are here nearly complete, as three parts out of four of the growing crops are removed from their native beds in the very beginning of winter (say sometime in Novem-

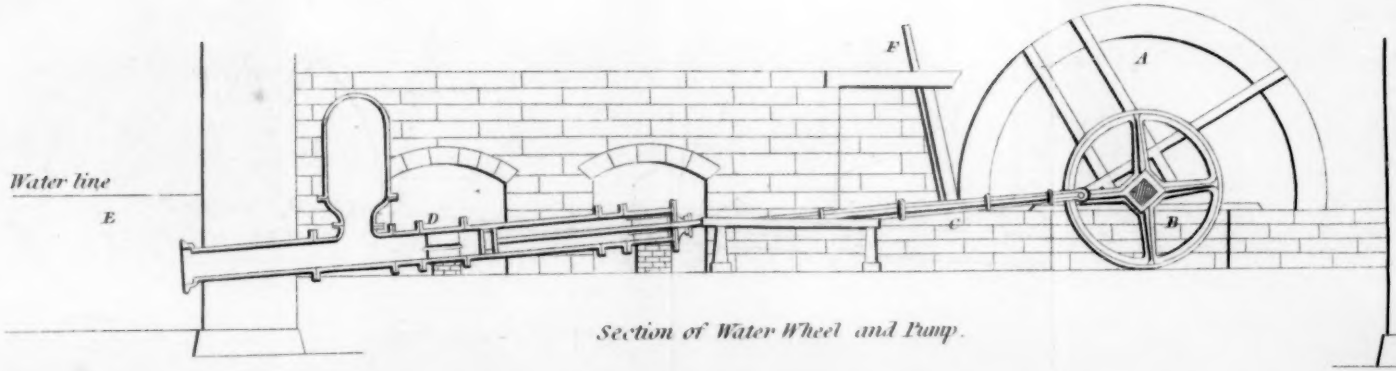
ber); and, deposited in trenches, continue for a considerable time in a state of suspended vegetation. The surface which is then turned up will be ameliorated by the frosts between that time and the early part of the spring; when, if the weather permit, the land may be ploughed *back again from the trenches*, and reap the advantages of a second earth in preparation for the following crop of corn. The turnips may, after this second ploughing, be most easily scattered about the field, which may be enriched by the feeding manure; or they may be carted off with so little injury to the land as to leave it in a very proper state for immediate sowing. But the peculiar advantage of this plan, and a most material one it is, consists in the wonderful facility with which turnips so defended may be got at, when those unprotected, or protected but in single rows, are fast bound by the frost. Here, as the whole of eight rows are collected into a small space, if the frost be extremely severe, the land will be kept open by the tops of four rows of turnips *united* in the lines 4 and 5, and being easily removed from the top of them, the whole body so collected will be exposed in a *sound* and *unfrozen* state. I conceive that it would be an *improvement* of this plan to use a little straw or haum for the purpose of covering the turnips before the mould is shovelled over them, as it would increase the facility of uncovering them, not only during the severity of the winter, but upon the dissolution of frost, and would keep them cleaner, and render them easier of access.

Perfectly efficacious as this mode was experimentally proved to be, it failed of giving general satisfaction to the *farmers*, who, objecting to the shovelling part of it, wished to have the whole of what was done confined to the powers of the plough. The last method, therefore, which I have made use of, was practically executed, thus. The eight rows of turnips growing as described in the last mentioned mode, were the whole of them pulled, and put as *upright* and *close as possible* into the trench opened between two ridges, and then lengthening the spindle of a wheel plough, or the pulling-tree of a foot plough, so as to enable the off-horse to walk clear and wide of the turnips, they were buried almost entirely by means of the plough, and the whole of the land was clean-ploughed, at the time of protecting them. In the beginning of the month of March 1803, it was satisfactorily evident that the turnips were completely preserved, and that the land had received the entire benefit of a winter's earth.

As to the advantages derived from ploughing, I regard this plan as very little, if at all superior to the last mentioned; and however the novelty of it, the facility of its execution, or the extreme neatness of its appearance when executed, may powerfully recommend it, I do not myself prefer it to the immediate foregoing mode, in which the casual advantages of shovelling *may* be very considerable, and I really think will always be sufficient to defray the expenses of that peculiar part of the operation.



Plan of Water Wheel and Pump.



Section of Water Wheel and Pump.

A description of the Water Wheel and Forcing Pump, used at the Philadelphia Water Works, constructed under the direction of FREDERICK GRAFF, *Esq.*

[With a plate.]

We have in preparation, a short history of the origin, progress, and present state, of the water-works, at Fair Mount, which will appear in an early number of the Journal. These works have been admired by all who have seen them, as monuments both of the taste and skill, of the persons concerned in the plan and erection of the buildings, and in the construction and execution of the machinery. We now present our readers with a *Plan* and *Section* of one of the water-wheels, and forcing pumps, engraved for Carey & Lea's edition of Nicholson's Operative Mechanic, from a drawing made by Mr. Graff. The accompanying description will be sufficiently full for those who understand the general structure of hydraulic machinery; and for that portion of our readers who have not this knowledge, we shall hereafter enter more particularly into those details which may be desirable to them; and we shall then have occasion to advert again to the accompanying plate, as we shall give a horizontal section of the pump, to exhibit the arrangement and action of the valves.

The pump is what is called the double forcing pump; producing an equal effect in raising water, in whichever direction the piston moves. The working barrel is 16 inches diameter in the clear, and the half stroke of the pump is 5 feet, giving 10 feet stroke for each revolution of the water-wheel, of which there are 13 in a minute. The water is forced to a perpendicular height of 96 feet, through mains of nearly 300 feet in length. The quantity raised, by one pump, in twenty-four hours, is upwards of 1¼ million of gallons, ale measure. The reservoirs are elevated fifty-six feet above the highest ground in the city.

A, plan of the water-wheel.
B, crank wheel.
C, connecting rod from the wheel to the pump.
D, plan of the pump.
E, the forebay, which supplies the wheel and pump with water.
FF, the gates to the forebay and water-wheel.

Some account of the late JAMES CROSS, *a journeyman Weaver, of Paisley, in Scotland.*

We have for some time past intended to devote a page or two to the memory of this talented and neglected individual. The following account of his merits, and of the treatment which he experienced from those who were enriching themselves by the use of improvements introduced by him in the art of weaving, is extracted from a spirited and interesting article "*On the necessity and the means of protecting*

needy genius," published in the *London Journal of Arts and Sciences*, for May, 1825.

When men lose their lives while engaged in deeds of noble daring, or in the prosecution of perilous enterprises, undertaken for the advancement of science, imagination illumines their graves with a sacred halo; even although they may perish, unseen, in the lonely desert, their setting sun still leaves behind, traces of glory, which, while we mourn the departed, afford us some consolation; but when an individual, whom nature has richly endowed, becomes the sport of fortune, and ultimately sinks into his dark grave, neglected and destitute, we feel poignant and unmitigated regret, at the recollection of his career, and his fate.

That mass of suffering in Great Britain, which now presses, not upon the operatives only, who are dependant on their daily labour for the means of living, but also upon their more wealthy employers, was, at the time of the decease of Cross, unfelt, and almost unanticipated; and were we ignorant of the history of human nature, and of the influence on society, of a redundant population, our surprise, when reviewing the case now submitted to notice, would equal our regret.

Whilst we rejoice in our own comparative exemption from the misfortunes which now weigh so heavily upon our transatlantic brethren, we should be careful to trace this exemption to its true source. Let us not arrogate to ourselves a superiority in virtue, merely because we are spared the evils, which result from entailed vice in government, and from an overflowing population. The blessings which we enjoy, should call forth our gratitude without exciting our vanity. Much of our practical independence, arises from a facility in changing our pursuits, and our places of residence, which is elsewhere unknown; and which is one of the blessings consequent on the extent and fertility of our country.

We might indulge ourselves in a continued train of reflection suggested by this subject, but our readers will probably prefer the narrative to the essay, and we, therefore, proceed to the extract.

"James Cross, the unfortunate and injured sufferer, was a humble mechanic at Paisley. At various times he had effected many important improvements in the weaving machinery, used for figured fabrics, which, by his unwearied application, he at length brought to such perfection, as with other great advantages, to render unnecessary, the use of draw boys. During the progress of his labours, he was frequently encouraged by the manufacturers of Paisley, who saw and fully appreciated the value of his genius, with hopes of ample remuneration for his persevering application. But when the inventions were pronounced complete, and *more than* his little means had been expended in arriving at this perfection, his only recompense was the high *verbal* approbation of his *munificent* and *benevolent* patrons; and that, too, *after they had been entirely satisfied by actual experience of the great worth of the inventions, and were daily reaping benefit from them.* The Board of Trustees for the improvement of manufactures in Scotland, awarded poor Cross a hundred guineas, which alone is a convincing argument in his favour; but this *liberal* gift was sunk in the perfec-

ting of his invention, and even then the poor victim was involved in debt. Unable to sustain such a pressure of accumulated misery, his health, previously injured by the privations he underwent to gather the means to prosecute his work, gave way to anguish and blighted hopes; and after more than twelve months lingering in expectation of at least a partial fulfilment of the brilliant prospects which had been held out to him, he died the broken-hearted sacrifice to avarice and base ingratitude, leaving a young, helpless, and motherless family, to inherit his PENURY and his FAME.

——— "What man seeing this
"And having human feeling, does not blush
"And hang his head, to think himself a man?"

"Mr. Cross's numerous inventions form a grand æra in the history of the art of weaving, and will be admired by posterity when the name and the woes of the humble author will have sunk together to oblivion; but we can here only give a brief outline of them. So early as 1804, he first commenced his observations upon the defects of the machinery then used for weaving, and almost every succeeding year his fertile genius produced some valuable improvement. In 1817-18, he made the first working model of his machine for weaving harness-work without the aid of draw-boys, and submitted it to the inspection of a number of manufacturers and operative weavers, who unanimously spoke of it with the highest encomiums.

"This model being on rather a contracted scale, and necessarily imperfect, he was strongly recommended to construct one of larger and more serviceable dimensions, and was given to understand, that his advisers would cheerfully pay every expense, whether or not his attempts were successful.

"Thus encouraged, he proceeded in his labours; but from many untoward circumstances, they this time proved unsatisfactory, after incurring an expense of £18 15*s.* 6*d.* To defray this, as he had been promised, a subscription collected amongst the manufacturers produced £12 15*s.* 6*d.*—leaving him a loser of £6, besides much valuable time. Notwithstanding these losses and frequent interruptions, from his very weak state of health, by persevering industry, during every moment's respite from disease, in 1820, he erected a larger machine. This he submitted to a committee of manufacturers and weavers, who very highly approved the principle, and *warmly* recommended a meeting, to 'consider the propriety' of remunerating him.

"A subscription for the purpose of enabling him to prosecute his labours yet farther, was the consequence of this meeting, and the *liberal* amount of the collection was £16 7*s.* 6*d.* from which poor Cross had to pay for wages, &c. upwards of £12. With the residue he was to "*prosecute his labours*,' and maintain his family (then six in number, and entirely dependent on him) for five months. Subsequently, being blest with a short return of comparatively good health, and yet undismayed by the pitiful encouragement he received, he finished another machine of more extended and perfect operation. This also, he laid before committees of weavers and manufacturers.

They were now so fully satisfied of his merits, that they this time gave *written testimonials* of their approbation; (one signed by eighteen, and another by fifteen individuals) and a general meeting was called to *reconsider* the propriety of rewarding him, to which the public were invited, by a circular letter *widely* distributed. At this meeting a statement* of the poor sufferer's numerous inventions was read, as also the flattering reports of the weavers and manufacturers, who had witnessed the operations of the completed machine; and the weavers were examined, who then had it in actual practice. A subscription again succeeded this parade of mock generosity, and produced the magnificent sum of £3 1*s.* 6*d.* Such was the noble fulfilment of all the enticing prospects held out to him—all the generous promises which induced him to sacrifice time and health, which might, and would otherwise have been employed advantageously for himself and family.

"In making the numerous experiments necessary to enable him to bring the invention to perfection, he expended money and contracted debts exceeding 100*l.* exclusively of the maintenance of his family during the long period that he was so engaged, and for this, the whole recompense he received from the manufacturers, amounted, as we have shown, to 31*l.* 14*s.* 6*d.*! He now became but too fully sensible how miserably he had been deluded, and oppressed by all the horrors of debts, which he saw no possibility of repaying: harassed by continual anxiety, both of body and mind, and the bitter conviction of his utter destitution, his energies gave way beneath the accumulated mass of wo, his enfeebled body became the prey of sickness, and he sunk into a state of entire helplessness. Thus he lingered, the miserable victim of his own powerful genius, till March, 1824, when, at the early age of 45, he was happily released from further earthly trouble. Previously to his death, he had the satisfaction of seeing his machine generally adopted by the *liberal* manufacturers, and several gave *written testimony* of the great benefit they derived from it.† The *noble* donation of the Board of Trustees came to cheer his

* Extract from the report of the manufacturers, &c., being the statement alluded to:—

"Amongst the many improvements which Mr. Cross has made for the trade, may be mentioned—The Eyed Standard for Gauze Mountings; the Back Hiddles for Pressure Harnesses; the Barrel Machine and Harness; the extending Tail for double Harness, for contracting the flowers, which in many cases, saves nearly one-half the expense of flower lashing, the pressing treddles, not being required as formerly.

"These have all been proved to be of great use."

† Extract from testimonies alluded to:—"The counterpoise, harness, and machine, has, in my estimation, a number of decided advantages, too many and important for any commendation on my part. In short, and in truth, I am so highly satisfied with the invention, that I do prefer it to all others for the same purpose, *and even to a draw-boy free of expense.*

Signed, William Clark."

"I shall only add, that I am perfectly satisfied with the machine, in all its departments; that I look upon it to he a highly useful invention, and shall ever

latter days also, but it was too late to renovate his worn out frame. But for the real benevolence of one individual, his four orphans, (three girls and a boy, the last but six years old,) must have become entirely destitute, and have suffered the very extreme of want. By his humane aid, however, and the employment of the eldest girl as a servant in one of the manufactories, as far as the calls of nature go, they are perhaps as well provided for as many of their neighbours in the same class, but not one of them has yet received *any education whatever*, and unless benevolence again exert itself, there seems no possibility of their ever obtaining it."

Mode of Digging a Canal During Frost.

The Polish General Sokolnicki, has given to the public an account of the manner he pursued in making a canal in the middle of winter, when the earth was frozen very deep, for the purpose of draining some ground in Poland.

The canal was traced out in the autumn with a strong plough; the borders were dug out three or four feet deep, and the space filled up with dung and a considerable quantity of straw; the surface was also divided by the plough into squares of three feet, for the purpose of determining the size of the blocks of earth which he intended should be removed; and, lastly, he prepared, at certain distances, inclined planes, that the sledges might go down to the bottom of the intended canal, which was to be four or five feet deep.

When the winter was set in, the ground sufficiently frozen and covered with snow, the excavation of the canal was begun. The workmen were directed to dig, with long pick-axes, trenches running horizontally under the frozen ground, and to introduce a sledge; wedges were then driven into the furrows, that had been made by the plough, when the ground was divided into squares; and the block being thus separated, settled upon the sledge, and was drawn away immediately, by teams of horses, and placed on the neighbouring fields to serve as manure.

In this manner he completed in three weeks, at the expense of about £280, a canal, for the execution of which, by contract, he had been asked upwards of £4000 sterling.—*Mechanic's Weekly Journal.*

Yandal's Calefier and Refrigerator.

A patent has been just obtained by Mr. Yandal for a new construction of apparatus for heating and cooling fluids, which appears to be

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feel grateful to Mr. Cross for his important exertion. I can now work when I please, and I am certain at all times of getting the work well executed.

Signed, JAS. FLEMYNG."

"I am ready to declare, without the smallest hesitation, that the machine so completely answers my purpose, that I esteem it infinitely preferable to all others, and would not exchange it for any draw-boy whatever, free of all charges.

Signed, JOHN MACPHERSON."

most effective in its operation, and far exceeding both in simplicity and economy any contrivance for the same purpose that we have before seen. It consists of two channels in contact with each other, the one, for the passage of wort or other heated fluid, the other, for cold water. These channels may be made of any breadth, by uniting thin plates of copper, but must be extremely shallow, that is the fluids must be distributed into very thin sheets, and pass over an extended surface, the length of the channels being made proportionate to their thickness.

We have seen wort received into the apparatus through pipes from the boiler at nearly a boiling temperature (170° Fahr.) and the cold water conducted into the other end of the apparatus from a well. On the wort discharging itself, after merely running through the apparatus, its temperature was reduced to 60° Fahr. and that of the cold water raised to 160° Fahr. which water it is proposed to conduct into a boiler, ready for the next mashing.

The form of the apparatus may be varied; its passages have been turned in a zig-zag, and also in a convolute curve; the principle consisting, not so much in the shape of the apparatus, as in its proportions. It has, we understand, been applied with considerable success to a steam-engine, as a condenser; but, in our opinion, it will not enable the air-pump to be dispensed with, which would be desirable, if possible, in consequence of its expensive construction, and its acting as a minus power on the engine.

As a condenser for distilled spirits, we have every reason to believe the apparatus will be found extremely valuable, having seen it applied in that way to the condensation of steam, and finding an equal quantity of distilled water discharged to that employed for cooling.

When the specification of this patent is enrolled (which will be in February) we shall take the earliest opportunity of laying it before our readers. [*London Journal of Arts.*

MECHANICS' SOCIETIES.

ASSOCIATED MECHANICS AND MANUFACTURERS OF NEW HAMPSHIRE.

We have received a copy of an address delivered before this society, on their 24th anniversary, which was celebrated at Portsmouth on the 5th of October last. The address was delivered by Abner Greenleaf, a member of the society, 'one who,' according to his own declaration, 'has been trained to the hammer, and whose means of acquiring an education have been otherwise extremely limited.' The whole address is creditable to the head and heart of the writer, and manifests considerable reading and industry. We should like to possess a copy of the constitution of this, and of all mechanics' societies in our country; in order that we might abstract and publish, such of their provisions as should appear most worthy of imitation, and which might serve as a guide in the formation of similar institutions.

PETERSBURG BENEVOLENT MECHANIC ASSOCIATION.

We do not know at what period this society was formed; it is however of many years standing; an act incorporating it, was last year passed by the Legislature of Virginia.

The society possesses a library, which is for the use of the members. They have also established a school for the gratuitous instruction of their children and apprentices, who have also, under proper regulations, free access to the library.

Apprentices of members who have served out their time with fidelity, receive certificates under the seal of the society, recommending them to encouragement and patronage, wherever they may sojourn.

French Patents, 1826.

To Berthol and Mariot, Chalons-sur-Saone, for improvements and additions to their patent of invention for the construction of roofs, ceilings, &c. 10th February—15 years.

P. Badeigts de Laborde, Saubuse, Dept. Landis, for an addition and improvement to his invention of an apparatus to manufacture essence of Thurbentine. 6th August—10 years.

Paturle, Lupin and Co. and C. A. Seydoux, Paris, rue Lepellitier, for improvements and additions to the patent of invention, for a machine called "Vaudoise," to comb wool. 7th April—15 years.

To F. Favre, Nantes, Department inferior Loire, for his invention of unalterable printing, or calender rollers. 7th April—5 years.

Madame Breton, Paris, for an improvement in nursing-tips. 30th June—5 years.

P. Masnyac, Lyons, Department Rhone, for improvements and additions to the patent of invention for manufacturing hats with feathers. 12th August, 1824—5 years.

M. Jongh, Warrington, England, for his importation of machinery to spin wool. 7th April—15 years.

J. F. H. Lamorineire, Paris, for improvements and additions to the invention to manufacture bricks, tiles, &c. 21st September, 1825—10 years.

J. C. Cloue, Paris, for his invention and improvements to Lithographic presses, 24th April—5 years.

Joanne Brothers, Mauzin, and Lewnite, Dijon, Department Coté d'Or, for improvements and additions to the invention for machinery to drive boats up rivers. 8th December, 1825—15 years.

J. G. Decaudin, Paris, for his invention of machinery to manufacture fringes. 24th April—10 years.

Madame Renaud Bainville, Givannis, Department Ardennes, for her invention of a machine called "Pluseuse," to clean wool. 24th April—5 years.

L. Dumery, Paris, for his invention of an improved water-wheel. 24th April—5 years.